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Turkish Air Force's experiences in chemical material acquisition

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THESIS

TURKISH AIR FORCE'S EXPERIENCES IN CHEMICAL MATERIAL ACQUISITION

by

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June 2002

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The purpose of this thesis is to examine the Turkish Air Force's experiences with the acquisition of chemical materials. It highlights the issues, concerns and risk areas associated with the chemical material acquisition and examines how the Turkish Air Force tries to mitigate the associated risks. In addition, it analyzes the chemical material acquisition from business perspective.

Due to operating in different environments, the Turkish Air Force and the private sector have different objectives in the acquisition of chemical materials. Turkish Air Force operates with excess amount of chemical materials in the inventory to prevent material outages. This attitude leads to shelf life expirations and testing processes in chemical materials. Conversely, business perceives inventories as costs and endeavors to reduce them to the maximum extent possible.

The conclusion is that Turkish Air Force is operating at a reasonable effectiveness level while fulfilling its chemical material needs. However, given the long procurement lead times and high rate of shelf life extension tests, the Turkish Air Force performs at a low efficiency level. Business practices employed in the acquisition of chemical materials offer viable alternatives to improve current acquisition methods.

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TURKISH AIR FORCE'S EXPERIENCES IN CHEMICAL MATERIAL ACQUISITION

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I. INTRODUCTION

A. BACKGROUND

Significant changes in the world have been effecting the environment in which Turkish Air Force is operating. Swift changes make it impossible to react to the issues with the same concepts and approaches that were viable a decade ago. Maintaining sophisticated military equipment requires a sophisticated logistics system. Implementation of information technology has enabled some improvements and reduced the waste of resources. Yet shrinking military budgets and declining personnel resources have still been exerting pressure on operating more effectively and efficiently without degrading the operational availability and readiness.

Within the logistics system, chemical material use has increased in Turkish Air Force. Even though most chemicals are considered as commodities in the private sector, the unique features that they carry differentiate them from other consumable materials and require special treatment in managing them. For instance some chemicals are neither durable nor long lasting. Depending on the chemical's nature, production processes or weather conditions, they have to be consumed in a certain period of time. This feature makes them life limited and perishable. Most chemicals can still be used after their shelf life expires. The chemical, however, must go through a testing process to see that it has not lost its characteristics and can still be consumed confidently. Yet, testing to extend the shelf life of a chemical is an elaborate and costly process.

In addition to the shelf-life issue, carrying chemical inventories incurs huge costs. They cannot be stored with other inventories in that they require special treatment. This means new infrastructure investments, personnel training and aligning the logistics system to cope with chemical materials. Consequently, the true costs of chemical materials go beyond the material cost itself. Once the chemical material is procured with the currently employed acquisition methods and accepted by the Turkish Air Force, there is almost no way to get rid of these costs.

The Turkish Air Force is not the only organization that consumes chemical materials, nor is it the largest consumer. The private sector also consumes large amounts

and various chemicals. The private sector, however, is much more responsive to coping with the changing environment. Intense competition enables innovations and brings creativity on how to manage chemical material procurement. Obviously, objectives of the Turkish Air Force are different than cost and profit focused commercial firms. Moreover, the Turkish Air Force operates with structured acquisition methods due to restrictive laws and regulations; the private sector virtually has no limitations on what method to employ.

Both the Turkish Air Force and the private sector, however, agree on a concept: reducing the input requirement for a given output. With limited resources, resource allocation is a concern for both sides. Therefore, the methods and concepts that are enjoyed by the business can incorporate potential benefits, be exactly compatible with the current laws / regulations and presumably be implemented by the Turkish Air Force.

In order to be proactive for prospective future and current issues, the Turkish Air Force should pay attention to commercial practices and lessons learned. Different outlooks invoke different points of view and foster innovation.

B. THE RESEARCH QUESTIONS

1. Primary Research Question

What is the Turkish Air Force's experience with the acquisition of chemical materials and how might this information be used to improve current acquisition methods?

2. Secondary Research Questions

a. What are the statutory/regulatory/organizational concepts associated with chemical material acquisition?

b. What are the current issues, problems and potential risks associated with the acquisition of chemical materials?

c. Currently, how does the Turkish Air Force mitigate the issues and risks associated with the acquisition of chemical materials?

d. What are the current best commercial chemical material acquisition practices?

e. Given the Turkish Air Force's experiences, how might they improve their chemical material acquisition practices?

C. SCOPE AND METHODOLOGY

1. Scope Of The Thesis

The scope will include: (1) a review of statutes, regulations and organizational concepts, (2) an analysis of the issues, problems and risk areas associated in chemical material acquisition, (3) an analysis of the tools utilized to mitigate the risk inherent in chemical material acquisition, (4) literature review regarding best commercial practices. The thesis will be an assessment of the currently implemented models and conclude with viable recommendations for prospective improvements.

2. Methodology

a. The methodology will include the following steps
b. Conduct a search of Turkish Procurement Law and regulations
c. Conduct a review of Air Force regulations and organizational concepts
d. Conduct a review of contract types/methods employed
e. Analyze the issues, problems inherent in chemical material acquisition
f. Examine the tools used to mitigate the risk and the associated issues
g. Conduct an Internet search and a comprehensive literature review
h. Conduct interviews with industry managers
i. Analyze commercial practices regarding chemical material acquisition
j. Identify target areas with possible improvements
k. Evaluate the feasibility of suggestions.

D. ORGANIZATION OF STUDY

This research is organized under five chapters. Chapter I is an introduction. Chapter II highlights the legal framework, provides the statutory, regulatory concepts that manage, restrict or involve chemical materials. Chapter III lays out the issues associated with the chemical materials and provides the current status of associated acquisition processes. Chapter IV focuses on how business conducts chemical material acquisition. The chapter discusses what business is concerned about and presents their implemented models to cope with identified concerns. The last chapter presents the researcher's conclusions and recommendations.

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II. OVERVIEW OF LEGAL FRAMEWORK

A. STATUTORY FRAMEWORK

1. Notices

The Ministry of Finance issues notices regarding the Government Procurement processes on an occasional basis. These notices provide extra guidelines for procuring agencies and clarify areas that which are not described or defined in detail in Procurement Law 2886.

In notice 99/1, "openness and competition" were stipulated as the fundamentals of Procurement Law and all agencies were held accountable to encourage implementation of these two principles. The Notice promulgates that the solicitation is the most important step in fostering both of the principles.

While Procurement Law addresses the concepts " Openness and competition" in the government procurement process, the Notice stipulates three main points to solidify the perception: publicity via newspapers, ads or posting the solicitation in public areas so far. First, Notice 99/1 approved the use of any kind of communication means to welcome as many bidders as possible. This commentary statement ignited the use of the Internet throughout the procuring agencies.

The second subject was the restriction from requesting unnecessary documentation from the bidders, for whatever reason, unless they are justified by the procuring agency. This statement targeted basically two typical attitudes. One of them was to eliminate the impediments to encourage competition and the other was to reduce unnecessary paperwork.

Unnecessary paperwork had been a long lasting concern in the business world (potential bidders for the government). Most companies thought that the Government Procurement process involved in so much detail that doing business with the Government had substantial opportunity costs. Thus, some companies didn't do any business with the government.

Another initiative was to dismiss any kind of design specifications. All agencies were prohibited from assigning any kind of technical function or design specification that

would or might restrict competition. All agencies were held accountable for utilizing performance specifications. As a matter of fact, this initiative stemmed from the widely accepted attitude of favoring brand names in procurement activities.

The notice also clarified the ways to collect the soundest estimated price of the item before the solicitation is released for public notice.

2. Procurement Law

a. The Procurement Law (# 2886)

Acquisition in Turkish Government Departments is governed by the "Government Procurement Law 2886". This law passed in the parliament on 8 September 1983. Since then, all Government agencies have been required to comply with the law while conducting any purchasing activities. The law covers all Government Agencies, including The Turkish Armed Forces. In the law, procurement is stated as a concept of meeting the agency's needs. It does not demonstrate an acquisition process where a cradle to grave concept prevails, but rather it just focuses on purchasing and perceives the process as a one-time action.

Also the restrictions and the authority imposed by the law are for decentralized procurement activities. These activities are the ones where agency requirements are sourced or met on their own supply system. For instance, an Air Force Base procures office supplies, buildings' maintenance services and, catering services out of its budget. The centralized department needs are not bound with this law and are processed by statutes instructed by The Ministry of Finance and passed by The Council Of Ministers. Major weapon systems, materials or services procured from foreign countries are examples of this sort of procurement.

The procurement law consists of 96 articles organized under five divisions. The first division addresses general principals. The scope, principles and acronyms are in this part. The second division prescribes the contracting types and procedures. The third section covers the requirements that are not bound by the law. Restrictions and responsibilities are stated in the fourth section. The last and the fifth section addresses miscellaneous provisions including the changes.

b. Concepts

Agencies are required to meet the agency needs

(1) Pursuing the Best Way

(2) With the Proper Conditions

(3) At the Right Time

The law stipulates "openness and competition" throughout the procurement process with two statutory provisions. Although these two terms are strongly emphasized, The Law does not go in details or broadly talk about what " openness and competition " means and what the law refers to.

The procuring agency is required to prepare a requirements document. This document consists of

1. Technical Specifications of the Service, Material Procured
2. Quantity
3. Estimated Price
4. Delivery Date
5. Inspection Methods
6. Bidder Qualifications
7. Responsibilities and Agency Rights

The Law addresses the concept of " openness" in article 17. The article sets forth the means of solicitation and particularly emphasizes soliciting via newspapers. The objective is to broaden the possible number of prospective bidders. Competition is encouraged by both the solicitation and the contracting methods. There are five different contracting methods stated under the procurement law.

1. Sealed Bidding
2. Restricted Sealed Bidding
3. Reverse Auction
4. Negotiations
5. Contests

Although Government Procurement has not been segregated under contracting methods, regarding the mechanics involved in the process, the first three methods involve almost the same features with some subtle distinctions. Notwithstanding

the diversification among the methods, all of them are price based sourcing of government needs. (Ref. 52)

3. Environmental Protection Law (#2872)

Environmental Protection Law was introduced on 9 August 1983. The law serves to protect and improve the environment, eliminate the abuse of natural resources, eliminate contamination and take precautions to cope with environmental problems. The law organizes and manages the actions and activities to reduce the detrimental effect on the environment. The law itself is comprised of 34 articles. The 13th article vests in the Ministry of Environment the authority to ban or restrict the quantity at imports, production, transportation, storage and use of chemical materials. In the article, chemical materials are regarded as the substances that demonstrate the feature of lingering in the water, air or earth, and harm the ecological balance. Apparently, the law doesn't address any particular chemical material under a name but states that they are declared by official communiqués when a case emerges. For instance, fire extinguisher gases, which damage the ozone layer, are an example. The import, production, sales, purchases and use [even if they exist in inventories] of these gases have been banned in mid 1990s. All corporations, contractors or potential buyers and, vendors must comply with this ban. (Ref. 51)

4. Law On The Protection Of Competition (#4054)

This law passed and was published on 13 December 1994. It was processed due to the government requirement in the 167th article of the constitution. The Law on the Protection of Competition consists of 65 articles. The purpose of the law is defined in Article 1.

> Article 1- The purpose of this law is to provide the protection of competition by ensuring necessary regulation, supervision and the prevention of abuse of dominant position by those enterprises which are dominant in the market and the agreements, decisions and practices which prevent, restrict or distort competition within the markets for goods and services. (Ref. 49)

The law aims to sustain competition in markets and preclude any attempt to eliminate it. Although the law does not address any particular government procurement or acquisition issues, it is highly correlated with the process. The law is somewhat unilateral in reality but not conceptually. Rather than prescribing requirements for both the

government and the bidders involved in the procurement process, it merely focuses on the transactions among the bidders.

The Competition Board implements the law. The Board itself works independently and doesn't stand in the hierarchical chart of the Government matrix. The Law does not include any executive procedures with which companies, corporations or government departments are to comply with in the course of business transactions. It simply conceptualizes the competition aspect and bans any kind of attitude, behavior, merger or acquisition that restricts, manipulates, or provokes free market dynamics.

The law and its passing date show a parallelism of the Turkish Government's endeavors to integrate its markets to the world markets. However, from another point of view, some applications are controversial to the law and contrast to the concept of competition. The law is not applicable to any Government regulated and dominated markets. (Ref. 40)

B. REGULATORY FRAMEWORK

MSY / 310-1 Acquisition Regulation

This regulation covers all procedures for the materials and, services that are acquired from foreign sources. It was renewed and registered on 26 January 2000.

All material or service acquisitions from foreign sources comply with this regulation. The Department of Defense manages for the Turkish Armed Forces' all types of major weapon systems, equipment support systems, and logistics supplies that are acquired from foreign countries and the services related to those acquisitions. The Department of Defense delegates its authority to the relevant force (Army, Navy, Air Force) depending on the nature of the material procured. The acquisitions are processed through offices organized in foreign countries by military attachés or individual military liaison officers stationed in the foreign country.

The Department of Defense procures major weapon systems and all initial material or service requirements directly related to that particular weapon system. Spare parts, stock complementary procurements, or material needs for maintenance / overhaul of existing systems are procured by each force. The objective is to complete all planned procurements in that particular fiscal year without extending to the next year. The goal of this principal is for accounting purposes. (Ref. 32)

C. ORGANIZATIONAL FRAMEWORK

ISO 9001 / ISO 14001

Only Air Supply and Maintenance Centers have implemented ISO series quality standards in the Turkish Air Force. Due to the relationship among the bases and the Air Supply and Maintenance Centers, the concepts have affected the entire command and have a positive impact on every process.

In Turkish Air Force, only Air Supply and Maintenance Centers are allowed to register for ISO standards. In fact, due to close relationships among the Air Bases and the Air Supply and Maintenance Centers, the standards have also affected the Air Bases.

ISO-9001 primarily focuses on "quality management" and what the organization does to satisfy the customer requirements. On the other hand, ISO-14001 is concerned with the environmental management. By simple definition, it aims to alter the processes of the organization to minimize and eliminate the harmful effects of the activities on the environment.

Both ISO standards are not product oriented, but process oriented (Ref. 25). All the processes are standardized and documented in the facility due to the requirements of the standards. However, the standards are subordinate to laws and Department of Defense regulations in the priority hierarchy. The laws and the Department of Defense regulations precede them. Therefore, they do not restrict or entirely change the procedures but document the way they are followed and systemize them, so that all overlaps in the allocation of resources can be eliminated and efficiency and effectiveness can be sustained.

D. CHAPTER SUMMARY

This chapter laid out the legal, regulatory and organizational framework that governs or affects chemical material acquisition in the Turkish Air Force.

The next chapter will highlight the associated issues and the contracting methods employed in chemical material acquisition in the Turkish Air Force.

III. OVERVIEW OF CHEMICAL MATERIALS ACQUISITION PROCESS & CONCEPTS IN TURKISH AIR FORCE

A. INTRODUCTION

The Turkish Air Force carries 903 different types of chemical materials in its inventory. Even though the number is a snapshot, there is not much variation in the number of chemicals used. This number soars to 1406 from a chemical lot / batch point of view. Shelf-Life expiration, and therefore retesting processes, are experienced frequently in Turkish Air Force. These aforementioned issues as well as inventory carrying costs increase the true cost of chemicals used in inventory. Therefore, how and where the chemicals are procured directly impacts the bottom line costs.

B. ISSUES & PROBLEMS

1. Shelf-Life

a. Shelf-Life

Shelf- life is one of the unique features of the chemical materials. Typically it stipulates the time period an item is usable. By a broadened definition:

> Shelf-life is the total period of time beginning with the date of manufacture, cure, assembly, or pack (subsistence only), that an item may remain in the combined whole (including manufacturer's) and retail storage systems, and still remain usable for issue and/or consumption by the end user. (Ref. 3)

In the commercial world, shelf-life materials are generally referred to as perishable materials. Perishability refers to the physical deterioration of the material while waiting to be used by the end user. Physical deterioration does not necessarily mean that the user or a person can observe the deterioration visually. In most cases it is barely possible to observe the deterioration without technical help. Even tough the item has deteriorated; it may not reflect the chemical reactions' visual features.

Shelf-life items are organized in two main categories in the Turkish Air Force; Type I and Type II. The main categorizer is the lifetime extension ability.

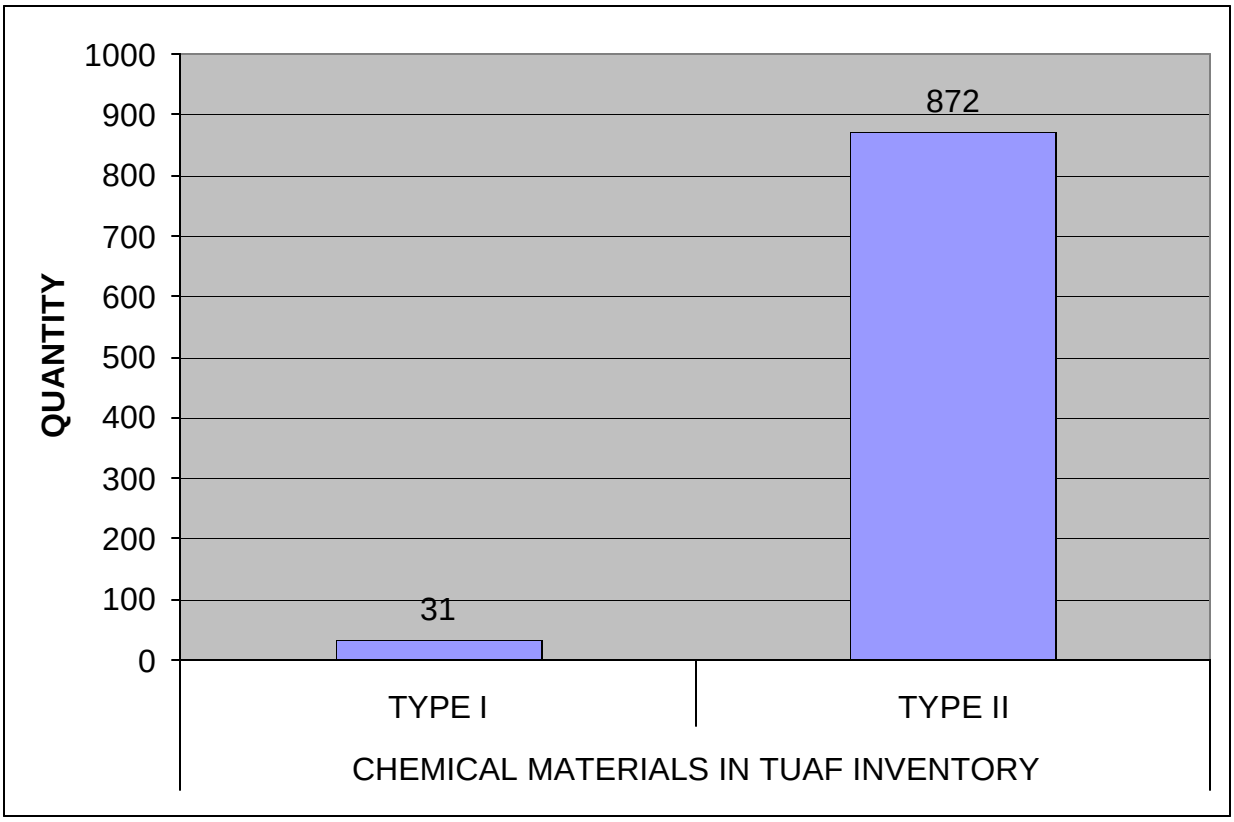

Table III .1 (After: Ref. 28) Chemical Materials In TUAF Inventory

b. Shelf-Life Codes

Shelf-Life Period	Type I	Type II
Nondeteriorative	O	O
1 Month	A	N/A
2 Months	B	N/A
3 Months	C	1
4 Months	D	N/A
5 Months	E	N/A
6 Months	F	2
9 Months	G	3
12 Months	H	4
15 Months	J	N/A
18 Months	K	5
21 Months	L	N/A
24 Months	M	6
27 Months	N	N/A
30 Months	P	N/A
36 Months	Q	7
48 Months	R	8
60 Months	S	9

Table III. 2 (After Ref. 47) Shelf Life Codes

As stated above Type I materials are given numeric codes, which stand for a lifetime period of the item. These are materials with a fixed lifetime. The utility of the item is restricted for a certain period. Lifetime of the material starts as soon as the material gets out of the production line. The item requires disposal if the shelf life expires.

A common misperception is that lifetime of a chemical starts with the delivery of the chemical to the user or storage area or right after accepting the chemical. It

is not rare that inventory personnel enter the delivery or acceptance day for the records. This is a high-risk practice. The inspection personnel must ask for the production date unless it is indicated on the label of the procured chemical. As a proactive step, the procurement personnel must put it forth as a requirement. If the Type I chemical shelf life was incorrectly entered, the material could be used after its real disposal day. This situation may lead to severe consequences, particularly in aerospace industry.

On the other hand, Type II materials are coded alphabetically and have an extendable lifetime. When the shelf life of a Type II chemical material expires, the item goes through a technical inspection. Either the military specifications (milspecs) or the manufacturer has already defined inspection criteria. The chemical materials that pass the inspection are assigned their new useful lifetime periods. The ones that fail are disposed of. Theoretically and practically, newly assigned lifetimes cannot surpass the original shelf-life of the material. In some cases, the examined material is assigned the same lifetime period as if it had been newly produced. However these are very rare cases and shouldn't be generalized. The practice and the attitude in the Turkish Air Force is halving the original lifetime of the item should it pass the inspection.

While the deterioration in Type I materials is internally dependant, it is externally dependant in Type II materials. Actually this is the reason Type I materials have a fixed lifetime. Outside factors do not impact Type I chemical materials as much as they do Type II chemical materials. In contrast, Type II chemicals are sensitive to outside factors. Even though handling and transportation affect the shelf life of a chemical, the main contributor is chemical storage. Manufacturer specified storage requirements help preserve and slow deterioration. Sustaining these requirements retards the deterioration of the chemical material. There are basically four factors pertaining to the storage.

c. Temperature

By and large temperature is the most important factor affecting the deterioration rate. Due to the diverse nature of chemical materials, it is virtually impossible to set a definite temperature for storing all chemicals. Segregation of materials is inevitable and item compatibility is the core issue to overcome this problem.

d. Humidity

Humidity is another important factor regarding chemical material shelf life. Packaging offsets this negative impact though. While penetration of humidity into the package speeds up deteriorative chemical reactions, precluding infiltration of humidity reduces the impact substantially.

e. Air Circulation

On its own, air circulation doesn't have much importance. However, lack of air circulation either increases or decreases the environmental climate causing artificially high or low temperatures. It is the temperature fluctuations that affect the chemical material.

f. Stowage

Likewise stowage creates artificial thus detrimental temperature changes. There should be sufficient room that lets air circulation and ventilation between the chemicals. In addition, stacking chemicals can jeopardize safety in the storage area. Any chemical spill, leaks or exposure to gases can be experienced due to stowage failures. Therefore chemical materials cannot be stowed tightly under the premise of optimizing limited warehouse space.

Even though rarely experienced, some chemical materials can be used for purposes different than the targeted use after the expiration of the shelf life. For instance, some petroleum products used for cleaning aircraft engine parts are also used as heating fuels for central heating systems. Another example is an intensive adhesive used in the aviation industry, which is still a qualified material for stationary in spite of its expired shelf life. Conceivably, this seems to prevent wasting resources and redirecting the chemical to a subordinate use. In fact, it might reduce the disposal costs substantially. However this is not a justification for over investing and piling up the material in the inventory assuming that it is going to be used in an alternative way.

g. Chemical Material Compatibility

All chemicals cannot be stored in the same place or adjacent to each other, depending on the nature of the chemical. Some chemicals are sensitive to each other and a sudden chemical reaction can occur. For instance, most oils can burn. Therefore, storing

them together with easily flammable gases would be very dangerous. Chemicals must be compatible with each other to be stored safely.

2. Hazardous Material / Disposal

There are two ongoing practices regarding the disposal of chemical material waste in the Turkish Air Force. All Turkish Air Force bases and Air Supply and Maintenance Centers are required to gather the chemical waste in designated and secured storage areas.

Periodically, disposed chemicals are turned over to MKEK (Machine & Chemical Industry Organization). MKEK is a state-owned company responsible for accepting and collecting all kinds of material waste from Turkish Air Force Bases or Air Supply and Maintenance Centers, upon declaration from the Turkish Air Force unit that waste was produced. MKEK recycles the waste, however, even if the chemical waste is not eligible for recycling and requires special disposal treatment. MKEK takes the waste from Turkish Air Force and disposes the chemical with its resources.

A second practice has been employed by the Air Supply and Maintenance Centers, which implemented ISO 14001 standard. In order to comply with the standard requirements, the Air Supply and Maintenance Centers is required to keep records of chemical waste and turns over the waste to a Ministry of Environment certified profit-oriented recycling facility. Depots also have their own recycling facilities for high volume chemicals like coolants.

As a matter of fact, only Depots are allowed to register for ISO 14001 14000 standard in Turkish Air Force. Therefore the bases do not embrace the latter practice. The motive of Air Bases is to get rid of the chemical waste via MKEK. Because it does not incur any costs and decrease their budget; profit-oriented recycling facilities charge Air Supply and Maintenance Centers for their processes.

3. Transportation

a. Transportation

90 % of the chemical materials used in Turkish Air Force are acquired from sources located in foreign countries (Ref. 28). Depending on the location, transportation is executed via ground or water. Duration of transporting chemical materials requires far more attention than spare parts transportation.

b. Shelf-Life

Once the chemical material is produced and is out of the assembly line, countdown on its lifetime starts. On some occasions in Turkish Air Force, the shelf life of the chemical has already expired when it is delivered to the inspection site. In some other cases, the chemical is in its shelf-life limits but has a relatively short lifetime left to be used or released. The latter case has almost the same far-reaching effect due to the inventory management concept in Turkish Air Force. The concept is based on a push system. Therefore, even if some requisition has been created in the system, the quantity need is definitely below the delivered quantity. Therefore, there is no immediate need for all chemicals delivered and some of the chemicals will be stored in the inventory for future use. As a matter of fact, the short lifetime on the delivered chemical renders potential future use impossible. Shelf-Life expiration of the chemical in inventory is high likely. This has been experienced particularly with Foreign Military Sales (FMS) deliveries.

On the other hand, transportation time is relatively shorter in Commercial Sales. In commercial sales, the profit-oriented contractor fulfills transportation requirements whereas it is the Turkish Air Force's responsibility in FMS or NATO Maintenance and Supply Agency (NAMSA) procurements. The sooner the profit oriented contractor delivers the chemicals the sooner it gets paid. Payment incentives urge the contractor to speed up the shipment process and shorten the transportation duration. Yet, the data indicate that the time lapse during shipment is negligible. It is the transactions and governmental activities, in other words red tape, that lengthens the process. Payment incentives drive the contractor to act proactively with respect to paperwork and customs issues; whereas there are no such incentives within the Turkish Air Force.

Once the chemical is passed onto the Turkish Air Force, all chemical materials are insured by Turkish Air Force. So the Turkish Air Force keeps paying the insurance as long as the transportation duration prolongs. This absolutely increases the true costs of the chemical materials as well as decreasing lifetime. Moreover, transportation also generates a pipeline inventory where there is temporary storage.

4. Chemical Material Storage

All chemical materials procured by the Air Logistic Command in a centralized manner are stored in one warehouse. The warehouse is located in the 1st Air Supply and Maintenance Center. The 1st Air Supply and Maintenance Center is responsible for overhauling and maintaining jet engines and frames, as well as producing spare parts. The center is the largest chemical material consumer in the Turkish Air Force (Ref. 28). The objective of consolidating the inventory is to reduce the necessary infrastructure, personnel and equipment investment to respond to unique chemical material characteristics. In addition to that, the lab, which is responsible for testing the shelf life expired chemicals, is also located in the center.

CHEMICAL MATERIALS STORAGE REQUIREMENTS (*)

CHEMICAL	STORAGE REQUIREMENTS
DYES and PASTES etc.	+ 4, + 38 ^{o}C
ADHESIVES	+ 4, + 26 ^{o}C
GASKETS and PLASTIC RINGS	+ 18, + 30 ^{o}C, 40 relative humidity
COMPOSITE MATERIAL	Under Controlled Temperature and Humidity
OILS, LUBRICANTS, COOLANTS	Water and Humidity Free Environment
PAINTS	+ 4, + 30 ^{o}C

(*) Materials are stored under conditions stated above unless specific criteria is determined

Table III. 3 (From: Ref. 47) Chemical Materials Storage Requirements

5. Military Specifications

91% of the chemical materials have military specifications (Ref. 23). Military specifications (Mil-Specs) are perceived as a strength in acquiring a chemical material. The premise is that military specifications guarantee the chemical is of high quality and can be confidently used in an overhaul and maintenance or production process. Most military specifications are stated in overhaul, maintenance Technical Orders. Therefore, the users persistently stress military specification requirements in an acquisition process. In contrast, mil-specs restrict the sources of chemical materials and discourage competition.

C. CONTRACTING METHODS & TYPES

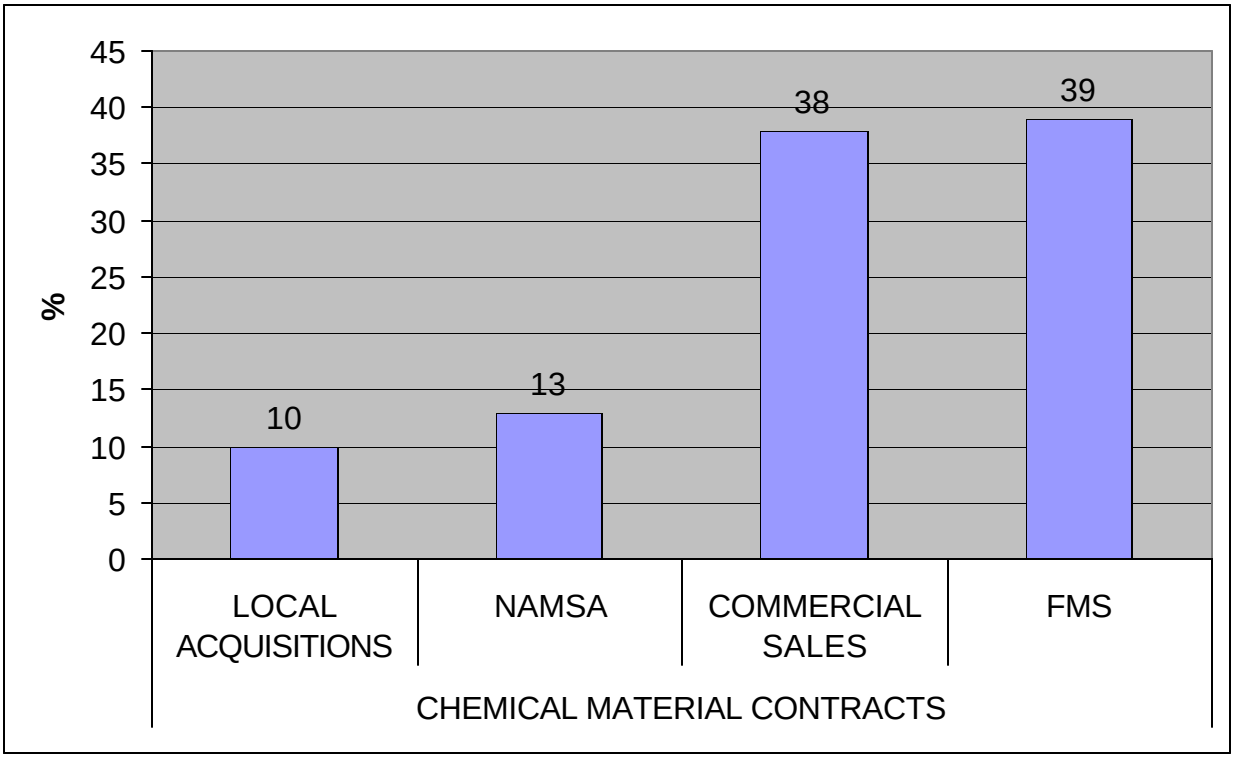

Table III. 4 (After: Ref. 28) Chemical Material Contracts

1. Foreign Military Sales (FMS)

FMS is one source utilized when procuring chemical materials. FMS is the largest contracting method for fulfilling the chemical material needs of the Turkish Air Force. Basically, an FMS program is government-to-government purchases of chemical

materials. The Turkish Air Force does not transact directly or contact with the manufacturer for any reason during the entire acquisition process. The United States Department of Defense operates as an intermediary, operating at all levels and processes of the acquisition.

When a chemical material need occurs, the Turkish Air Force requests information regarding the price and availability. Approval of the item's sale is a requirement for releasing the price and availability data. The U.S. Defense Logistics Agency is the Department of Defense organization that processes the Turkish Air Force's chemical material acquisitions. The Defense Logistics Agency purchases chemicals from U.S. manufacturers or directly meets the need from its warehouse, if available. U.S. Federal Acquisition Regulation rules apply throughout the procurement and THE Turkish Air Force does not get involved in the process. The Turkish Armed Forces Attaché in Washington conducts the payment upon receipt of paperwork. Upon the procurement Defense Logistics Agency hands over the chemicals to the designated liaison officer to be shipped to Turkey. All chemicals are insured immediately after received from the U.S. authorities.

Chemical material procurement by FMS is issued for planned and well-organized material needs. The premise is to take advantage of economies of scale and bring the unit costs down. While its use is viable in terms of cost reduction, long procurement lead times increase the shelf-life expiration risks. It is never used for urgent needs, where operational availability is endangered unless the user need is to be met in a certain period of time.

2. Commercial Sales

The second biggest portion of chemical materials in Turkish Air Force inventory is acquired through commercial sales from U.S. manufacturers. The Turkish Air Force has increasingly been practicing commercial sales in recent years. Procedures to process commercial sales are articulated in Department of Defense regulation MSY / 310-1 and comply with the Turkish Procurement Law article # 51-P. While acquiring chemical materials via commercial sales the Turkish Air Force can transact the procurement either directly with the manufacturer or with a third party who goes through the transaction with the manufacturer on its own; for instance a distributor. Logistics liaison officers can also conduct chemical material procurements individually in the U.S. under commercial sales.

This is entirely in compliance with the regulation and the law and is assigned to get rid of red tape when urgent chemical needs emerge and absence of the chemicals endangers operational availability, scheduled maintenance, overhaul programs, etc. Commercial sales utilize either negotiations, sealed bid processes or sealed bid with accelerated payments. The negotiations are conducted by liaison officers stationed in the United States. Sealed bid processes are conducted and awardees are determined by the authorized team in the Turkish Air Force.

3. Local Acquisition

Approximately 10% of chemical materials in the inventory are procured through domestic sources in Turkey. All these chemicals are not necessarily produced in the country, but all are entirely commercial-off the shelf products and consumed in Turkish markets. Chemical material needs met from domestic markets are not consolidated by Air Logistic Command as opposed to needs met via NAMSA, FMS or Commercial Sales. Every procuring agency is responsible for its own needs and conducts the procurement activities under the authority of the agency head. The necessary funds for acquiring chemical materials are earmarked by the Department of Finance at the beginning of each fiscal year. The agency is empowered to use the funds only for the chemical materials for which the funds were allocated. Reprogramming of funds is allowed only if the predetermined chemical material needs are met. There is a clear distinction between local acquisition and NAMSA, FMS and Commercial Sales. Once a chemical is designated to be procured from local markets, it cannot be procured from the latter sources unless there is justifiable reason. Typically three contracting types are pursued in local chemical acquisition: negotiations, sealed bids and reverse auctions.

4. Namsa

NAMSA stands for the NATO Maintenance and Supply Agency. For all materials, the agency submits a six months warranty. A few types of chemicals used in the Turkish Air Force are procured from NAMSA. Actually NAMSA can be regarded as a source rather than a contacting type or method. The procedures are structured when acquiring chemical materials from NAMSA. The Turkish Air Force submits its chemical material needs. The agency doesn't guarantee meeting the need and the price is not

predetermined. No negotiations occur between the agency and the country. However, the request is binding and the agency is responsible for replying to the country's request.

NAMSA operates under the premise of consolidating material needs of member countries. By consolidation, competition is increased and the agency leverages economies of scale. NAMSA fulfills requisitions from:

1. The Agency's Stocks
2. Member Country's Stocks (Declared As Excess)
3. U.S.A. Military Warehouses With the Use of FMS
4. Commercial Markets (Ref. 32)

NAMSA is almost a guaranteed source for a few chemicals. Procurement lead-time is relatively short compared to FMS. NAMSA procurements are conducted via electronic data interchange and are never used for urgent needs.

5. Contracting Methods

There are four contracting methods that are employed in chemical material procurement.

1. Sealed Bid
2. Sealed Bid with Accelerated Payments
3. Reverse Auction
4. Negotiations

The first three methods have similar characteristics.

a. Sealed Bid

The requirement for sealed bids is that the chemical material is not procured from one source, but from multiple sources. It is important that dynamic market forces drive the price of the chemical down and no one dominates the market. The premise is that there will be competition among the bidders and that the competition will lead to a reasonable price for the Government.

The lowest offer is awarded the contract with a " Sealed Bid", and every bidder is assumed to accept all terms and conditions stated in the invitation for bid.

Reliability and trustworthiness of the source is not addressed through the source selection process. Actually, the source selection authority does not evaluate the

responsibility of the bidder. Every year contractors who have been barred from bidding in government contracts are listed. If offerors are in the list, their bid is regarded as invalid.

b. Sealed Bid With Accelerated Payments

This contracting method has almost the same features as the sealed bid. The difference is a liaison officer is authorized to eliminate steps in the sealed bid process to speed up the process. The liaison officer eliminates the associated paperwork to conduct chemical material acquisition under a normal priority acquisition. This method is used under urgent chemical material requirements.

c. Negotiations

Negotiations involve dealing with the source face-to-face and bargaining on the item. Negotiations are utilized when it is a sole source procurement and/or the chemical material need is urgent. There are no structural procedures for conducting a negotiation. Cost issues are subordinated in negotiations. Fulfilling the material requirement is the most important objective.

d. Reverse Auction

Reverse Auctions are only used in decentralized chemical procurements. The thrust behind the concept is almost the same as the sealed bid method. The only difference is that bidders are allowed to make only one offer with sealed bids; in a reverse auction, the bidders can make as many offers as they want. Reverse auctions go on until a bidder offers the lowest price and no other bidders can beat that price.

D. RISK MANAGEMENT

1. Risk Management

" Risk " is mostly defined as the likelihood of events happening that could have an impact on the organization's objectives or on the organization itself. There are two important elements of risk.

- What's the likelihood of something occurring?
- What are the consequences?

In terms of chemical material acquisition, the Turkish Air Force does not have an explicit risk management policy, technique etc., mandated by law, regulation or encouraged by guidance.

Risks associated with chemical material acquisitions are not addressed or emphasized explicitly. Therefore, in terms of chemical material acquisitions, risk management can be analyzed based on implied risk management methods in processes rather than a systematic approach.

2. Objective

All resources in Turkish Air Force are directed to fulfill the Operational Availability requirements. Therefore, failing to sustain Operational Availability is perceived as the most detrimental risk. The following chart outlines some consequences associated with timeline and cost related risks.

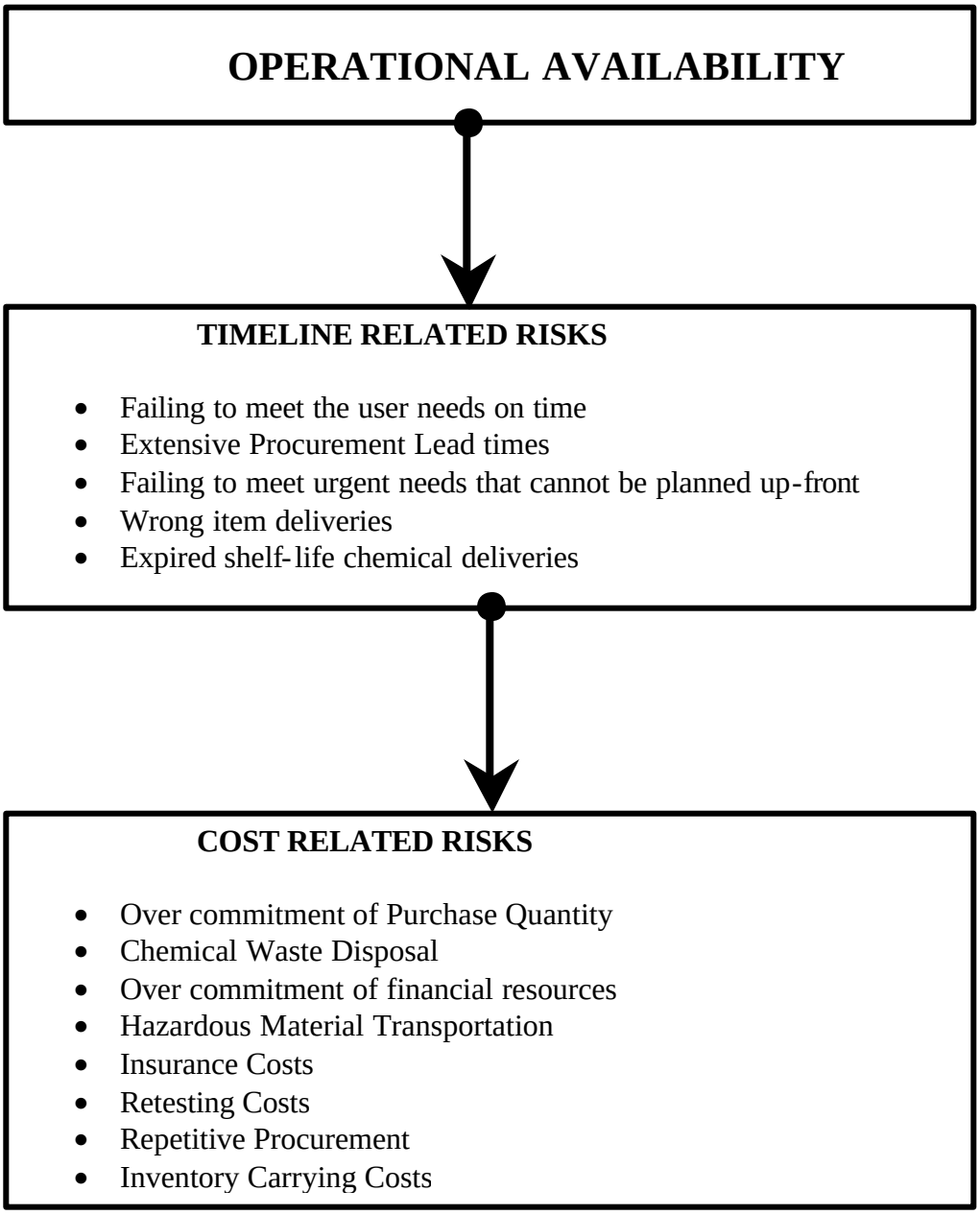

Table III. 5 Timeline And Cost Related Risks

3. Consolidation Of Requirements

Chemical material requirements are determined in two ways.

1. Centralized
2. Decentralized

As stated previously, 90% of chemicals in the Turkish Air Force inventory are procured via NAMSA, FMS and Commercial Sales from foreign countries. These chemical materials are acquired in a centralized manner. The requirements are consolidated by RDS (Requirements Distribution System).

Chemical materials are managed by RDS (Requirements Distribution System), which is a network system managed by Air Logistic Command. Every Air Force Unit (Bases, Air Depots etc.) has access to that database system. 90% of the chemicals are managed by RDS in the Turkish Air Force (Ref. 28). Chemical requisitions and consumption are registered in the database records. At the end of every three months, the system produces requirement demands via statistical modeling. Depending on historical requisition and consumption of each chemical, RDS computes projected consumption for the next three quarters. Simultaneously considering the amount carried in the inventory, RDS prints out the amount of the chemical that should be purchased to guarantee the minimum inventory requirement. RDS consolidates the requirements and eliminates over purchasing. However, there is still some contingency level built in the system to prevent material shortages. This practice eliminates the direct human intervention in constituting the purchasing quantity. A common practice is that the users tend to overestimate their chemical material needs. There are two factors behind this attitude.

First is to guarantee some extra chemical material, which might be necessary in case an unplanned, immediate need occurs. The second is the rational ignorance of the associated cost of purchasing the chemical. Centrally managed chemical material costs are not borne by the user units (Bases, Air Depots). Therefore there is no incentive to optimize the financial resources and the chemical material needs. Use of RDS prevents unnecessary overestimated quantity purchases of chemical materials with the help of sophisticated statistical models.

RDS projections are not the only projections given before a procurement process is started. Every user unit is asked to submit a written report on its prospective chemical material needs. After all reports are received from the users, the reports and the RDS projection is compared. This is processed as a proactive measure to see whether there are unexplainable and unreasonable quantity gaps.

Centralized procurement also enables consolidation of chemical materials. Consolidation facilitates competition and provides decreased unit costs due to economies of scale. Furthermore, all costs associated with the process: transportation, insurance, packaging etc., are reduced by consolidating chemical material needs.

The user units procure approximately 10% of chemicals in a decentralized manner. The user units have latitude to plan and manage the procurement process for these chemicals. The ability to reprogram funds and decentralized decision-making leads to optimization of chemical material needs. Thus, shelf-life expirations, disposals due to chemical obsolescence and re-testing are very rarely experienced among the chemicals procured by user units from domestic sources.

Centralization, leading to consolidation, is considered as reducing the risk of over purchasing and wasting financial resources. The procurement process is managed by only one point and duplicative efforts are eliminated. However, by its nature RDS operates under a push system as opposed to a pull system. It automatically incorporates contingencies and makes sure the inventory carries extra chemical materials. Frequent chemical shelf-life expirations are caused by this operational nature and mostly experienced with the chemicals procured centrally via FMS and NAMSA.

4. Deficiency Reports

Typically there are five kinds of deficiencies that might be encountered while inspecting of delivered chemicals.

- Quantity Discrepancies
- Wrong Item Delivery
- Expired Shelf-life
- N / A Manufacturing Date
- Damaged Packaging

To prevent the potential losses due to aforementioned defects, the Turkish Air Force uses deficiency reports for all chemicals from every source.

For the chemicals procured via FMS, Supply Form (SF) 364 (Ref. 32) is filled out and submitted if a deficiency is detected. A SF-364 is submitted only if the price of the chemical materials is above $200. Deficiencies cannot be summed up to surpass the $200 threshold. Every chemical item stands alone. Even if there is more than one defect in a

delivered group of chemicals totaling more than $200, deficiencies cannot be summed up unless they involve the same chemical material.

Form 672 is used for deficiencies detected in chemicals sourced from NAMSA (Ref. 32). Almost all requirements are the same as with SF-364, except the threshold. A form 672 can be submitted above a threshold of $25.

Deficiency reports reduce the risk of receiving a useless chemical and guarantee that the Turkish Air Force will be reimbursed for defects for which the source is accountable.

On the other hand, deficiency reports might not yield the desired results for chemicals with an "N/A Manufacturing Date". Rather they might defeat the purpose. When the chemical material data sheet or the posted label does not indicate a certain manufacturing date, it is not possible to assign a shelf-life expiration date or even determine if the item is good for use. When the deficiency report is processed because of N/A manufacturing date, it takes a relatively long time to receive the reply from the manufacturer. Time lapse can cause the material to reach its shelf life and sometimes the information sought becomes unnecessary when received. The chemical is already in the re-testing process. Had the chemical gone through the re-testing process as soon as it was received, it could already have been issued for use and time wasted could be eliminated. The deficiency reports stretch the procurement lead-time in these cases.

For Direct Commercial Sales or user purchases the practice is similar. The inspection committee issues a written material deficiency report to the contractor specifying the nature of the deficiency detected. However, acceptance of the delivered items is in its entirety in commercial sales or user purchases. Therefore, a line item cannot be segregated from the contract scope while the other line items are accepted.

The deficiency report obviously mitigates the risks that the Turkish Air Force might encounter. However when there is a problem with one of the chemicals, the whole contracted amount of chemicals are held in suspense until the usefulness of the problematic chemical is determined. The contractors are entitled to correct their mistakes for a limited period of time. Yet the other chemicals cannot be issued for use and cannot be stored in a place other than the inspection area, which usually does not provide any necessary conditions for properly storing chemical materials.

5. Military Specifications

89% of the chemicals in the inventory have military-specifications (Ref.28). Mil-Specs are considered as a risk-reducing element in chemical material procurement. Supposedly substituting these chemicals with chemicals used in commercial markets can be precluded in an acquisition process. In most TOs (Technical Orders), the mil-spec of a chemical material is described. The procurement process of a chemical assigns the mil-spec to comply with the requirements in the TO. However most of those TOs were written when mil-specs were appreciated and regarded as a necessity. Now improving commercial chemical material markets can provide much more than they did in the past. Therefore the mil-spec concept should be revised to take advantage of commercial markets.

6. Urgency

If an urgent chemical material need arises, the chemical is procured via commercial sales. Two contracting methods are used:

1. Negotiations
2. Sealed Bid with Accelerated Payments

In both cases the thrust is shortening the procurement lead-time and fulfilling the user need as soon as possible. The liaison officer is delegated the authority to conduct the negotiation and make the payments. The funds allocated for the procurement cannot be reprogrammed or used for another type of chemical. Authorization is also given for each procurement as well as the funds. Every time a need occurs, a liaison officer must be authorized to conduct the negotiations. Liaison officers are encouraged to conduct market research. The market research is driven by delivery time because of the urgency, not merely by cost issues.

A sealed bid with accelerated payments method is implemented when the estimated purchase value prevents using negotiations and there is more than one responsive manufacturer in the market. The liaison officers are authorized to solicit at least three bids from three different parties. Competition and the short delivery time are sought by employing the sealed bid method. Paperwork is reduced to the extent possible and payments are made through liaison officers to expedite the chemical acquisition process.

7. Chemical Material Testing Process

Even though the testing process increases the life cycle cost of a chemical material, positive test results may extend shelf life, thus preventing chemical material shortages. Therefore, the testing process can be deemed as a risk reduction method. On the contrary, repetitive positive results may drive acquisition personnel to overpurchase chemical materials.

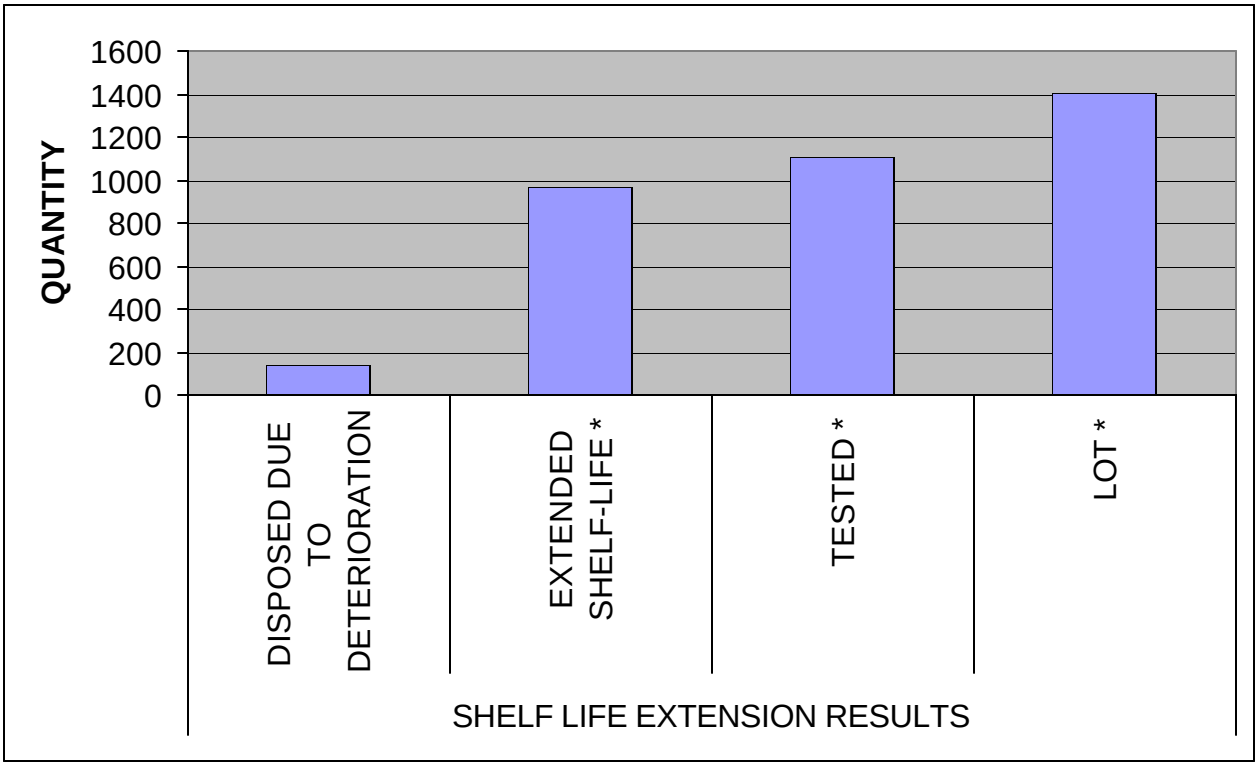

Table III. 6 (After: Ref. 28) Shelf Life Extension Results

The data above are based on chemical lots and reflect 2001 data. The data demonstrate that 78% of the chemicals in the inventory went through a testing process. 87% of the tested chemicals (68% of the entire inventory) were granted lifetime extension whereas 13% of the chemicals (10% of the entire inventory) were disposed due to material deterioration. The attitude is to extend the shelf life no more than half of the original

manufacturer determined shelf life. If the manufacturer assigns a six month shelf-life period to a chemical, no more than three additional months shelf life is granted if the chemical passes the test. (Ref. 28)

E. CHAPTER SUMMARY

This chapter illustrated the issues and problems associated with the acquisition of chemical materials. It provided the sources and the contracting methods used when procuring chemical materials. Additionally it discussed various risk management techniques used to acquire chemical materials for the Turkish Air Force.

The next chapter will highlight the issues and concerns associated with chemical material acquisition from a business point of view. It will also discuss commercial practices employed in chemical material acquisition.

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IV. COMMERCIAL PRACTICES

A. INTRODUCTION

In the United States, manufacturing companies consume approximately $112 Billion worth of chemicals per year (Ref. 26). Cost oriented commercial companies have different concerns and issues regarding chemical materials. The commercial companies consider chemical materials as commodities. Therefore the methods employed when procuring chemical materials are not different from those used for commodities in general. The objective is to cut costs to the maximum extent possible without forgoing the targeted quality in the end product. Maybe Chemical Management Services can be deemed as an appropriate acquisition model to mitigate the risks associated with chemical materials management. CMS uses a strategic, long-term relationship between the buyer and the service provider in which the perception is not selling chemicals to a buyer but rather managing the customer's chemicals and any kind of process affiliated with chemical materials. Yet, even Chemical Management Services (CMS) use performance based contract concepts and value engineering, which are common and highly appreciated by industry.

Implementing Just In Time Acquisition, Electronic Data Interchange, and Long-Term Contracts in a company all at once is as viable as implementing only one of them. They do not necessarily clash with each other or with Chemical Management Services. It is not a conflict that forces the company to go only one-way. All can be used in a harmony. The issue is to ensure the benefits of the employed method/s in terms of costs reduced.

The commercial companies do not focus on shelf-life expiration or chemical waste disposal due to material deterioration, rather they attack the inventories in the first place. The premise is as long as the company reduces inventories, shelf-life expirations or chemical waste disposal, which are by-products of swollen inventories, are also reduced.

B. ISSUES & CONCERNS

1. Cost Focus

The objective of a private company is profit maximization in the business environment. A company can pursue this objective by applying different strategies. Expanding the production capacity, segmenting markets, implementing innovative marketing strategies, etc., are only a few. A company can employ one or more strategy for profit maximization depending on its characteristics, culture or operating environment.

Another way to maximize profit is to minimize the input required for the end product. The distinction between profit maximization and input minimization is that even though the strategies for the former vary for the companies, the strategy for the latter is almost the same for all companies. It focuses on reducing costs. It is even the same for non-profit organizations, which supposedly do not seek any profits. Therefore, directly or indirectly, cost reduction is the core issue for every business entity to mitigate the risks of survivability. Typically, cost reduction is driven by five basic concerns.

1. The shareholders who want a reasonable, continuing return on their investment.
2. The employees who want a continuing, constantly increasing price for their services.
3. The consumers who want a reasonable, continuing price policy that fits their budget.
4. Intense competition to stay in business.
5. The stakeholders who want to make the company competitive to reduce unknown future consequences.

A few companies have specific requirements, however most of the private sector views chemicals as commodities. Nearly all entities pay the going market price for the procured chemicals. The company is urged to leverage sound management of resources. A cost reduction focus emerges as the by-product of effective management. As long as a company is able to reduce its costs, it can maintain a comparative advantage over its competitors.

Competition has soared and has become intense in recent years. It has squeezed profits eroding the ability to raise end product prices proportionately. This has been the vigorous thrust behind striking against costs. Cost reductions in a company are not an

arbitrary desire to cutback on every expense line item. Cost reduction is a form of risk reduction, yet often it is confused with cost avoidance. It is not forgoing any opportunities or drawing back from essential expenditures under the premise of savings, but rather reducing the monetary value of the raw materials, or the value added step requirements for a given output. It is not reducing R&D spending, overtime payments, retarding salary increases, etc. Cost reductions are derived mostly from,

1. Reducing material costs through quantity discounts
2. Reducing warehouse rent through reduced inventory
3. Reducing chemical materials through substitution, reducing dependency, technological innovations
4. Reducing fixed asset costs including testing equipments and storage areas
5. Reducing overhead costs
6. Reducing administrative costs
7. Reducing disposal costs
8. Reducing transaction costs

Reducing costs reduces the risks incorporated in the unknown dynamics of the market place, both in the short and long run.

2. Inventory Reduction

A survey demonstrates that 82% of senior executives are concerned about swollen inventories and see inventory reduction as a major concern (Ref. 17). Intense competition in the market urges entities to respond quickly to changes in customer demands and to do it with little inventory to gain a competitive edge. This responsiveness requires carrying smaller inventories. In the past, companies used to pile up large input inventories to be ready for future production demands which is yet unknown at the moment. Forecasted demand driven inventories are

- Hard to control
- Inefficient
- Costly

Generally, there are two types of inventories; input inventories and finished product inventories. Input inventories comprise raw materials, parts used for production,

components, etc. Regardless of its type, all inventories incurs huge costs pertaining to material procurement and inventory carrying costs.

Well-planned and well-managed inventories contribute to the efficiency and effectiveness of a company, making it more competitive in the business environment. Consequently, the company eliminates huge costs and contingencies by eliminating excessive inventories; this reduces the risk regarding survival in the market environment by providing a competitive edge over competitors.

Inventory carrying costs are typically

1. Opportunity Costs of Tied / Allocated Resources
2. High Insurance Costs
3. Warehouse Rent / Lease Costs
4. Obsolescence and Deterioration Costs
5. Personnel Costs
6. Disposal Costs
7. Test Costs

Inventory carrying costs can be as high as 25% of the value of the inventory (Ref. 13). In some industries, inventories can be the second largest asset in monetary value after physical facilities and machinery. Given the high cost associated with inventory, it is no wonder that senior executives have embraced inventory reduction strategies to enhance their competitiveness.

3. Cost Of Capital

Every action taken to reduce the inherent risks in conducting business or in decision-making processes involve particular costs associated with that action. Implementing tools to reduce the risks in acquiring of materials or services may range from changing policies to adopting sourcing strategies such as Just In Time procurement. The only thing that stays common is that each tool will definitely incur costs for the company. However these costs do not reflect the true costs born by the company. Cost of capital required for the investment should be included as a part of implementation costs. Then a company can see the true costs of its actions. Any forecasted gains or cost savings after the investment should outweigh the costs incurred due to the investment. The end should justify the means to achieve the objectives in terms of cost.

Other than their own assets, companies also operate on borrowed money. The borrowed capital components depend mainly on two sources. One of them is the debt obtained from the capital markets. The other one is the equity obtained from the shareholders.

Each company employs different capital component percentages. Cost of capital depends on the risk of the firm's cash flows. A company's rating in the capital market drives the cost of debt sought in the capital markets. If the rating is high, the cost of debt decreases. However, if the company has bad debt ratings, the gap between the true cost of materials and the material cost itself gets wider. As a result, the company might wind up paying substantially higher prices for chemical materials compared to its competitors or compared to that particular material's going market price.

3. Time Value Of Money

Another issue worth noting is the time value of money. The same monetary prices do not reflect the same values in two different time settings.

To give an example, suppose Company A procures a chemical and promptly makes the payment at the time of delivery. On the other hand, Company B procures the same chemical but makes the same payment three months later than the delivery. Even though on official records the same number will appear, the true costs of the chemical will be different for each company. In the following example, assume:

PV= Present Value

FV=Future Value

I=Interest Rate =5%

X= # of months=3

n=1 Year

$$PV = FV / (1 + I * X / 12)^{n}$$

Months	0	1	2	3	Company A
		PV=$100			
Months	0	1	2	3	Company B
		PV=?			$100

The true cost of the chemical for Company B can be found by the calculation of Present Value.

PV=$98.76

In reality Company B has paid $98.76 whereas Company A has paid $100 for the same type of chemical delivered at the same time. The difference might seem small, even negligible. However, for production facilities that continuously use substantial chemicals, cost savings can be impressive. A company's image, trustworthiness, reputation and financial status are definitive in spreading the payments over time. It gives the company a competitive edge on reduced material costs and enables the company to shift some part of the cost onto the vendor.

5. Quantity Discounts

Quantity discounts can also impact the unit price of chemical materials. Quantity discounts can be correlated with the seller's production capacity/batches, seasonal effects or fluctuating market prices. Even though quantity discounts may seem attractive, they may have an adverse effect on the life cycle cost of the chemicals. Inventory carrying costs, prospective shelf life expirations, testing costs and disposal costs can outweigh the potential savings associated with the quantity discounts. Therefore, management should pay close attention to supposedly attractive discount offers and prevent overpurchasing under the premise of discount savings.

C. CURRENTLY EMPLOYED METHODS FOR RISK REDUCTION

1. Just In Time Acquisition Strategies (JIT)

a. Concept

In traditional sense, production facilities tend to carry a certain amount of finished products in their inventories to meet future customer needs. This is a contingency

approach that ties up capital in excess inventory. The excess inventory may or may not be consumed prior to shelf life expiration.

The philosophy behind JIT acquisition is to reduce the huge inventories carried by the facility. Inventory is the resource to meet the future customer demand. The source is idle in that the customer demand that justifies the inventory hasn't occurred yet. Under this practice the facility operates within a push principle. Goods are produced and stored for a forecasted future demand. As a result the entire cycle is aligned with the push concept. And all inputs required to produce the forecasted demand are procured up-front and stored in the facility.

JIT acquisition strategies focus on delivering the right quantity at the right time with the desired quality. The objective is to minimize the inventory, thus eliminating the costs associated with carrying the inventory: facilities, personnel, transportation etc. JIT acquisition regards the production process as an entirely integrated cycle by eliminating the need for contingency stocks. Presumably this requires a tightened and streamlined information flow among the sales, manufacturing and procurement departments. This concept is essential for chemical materials.

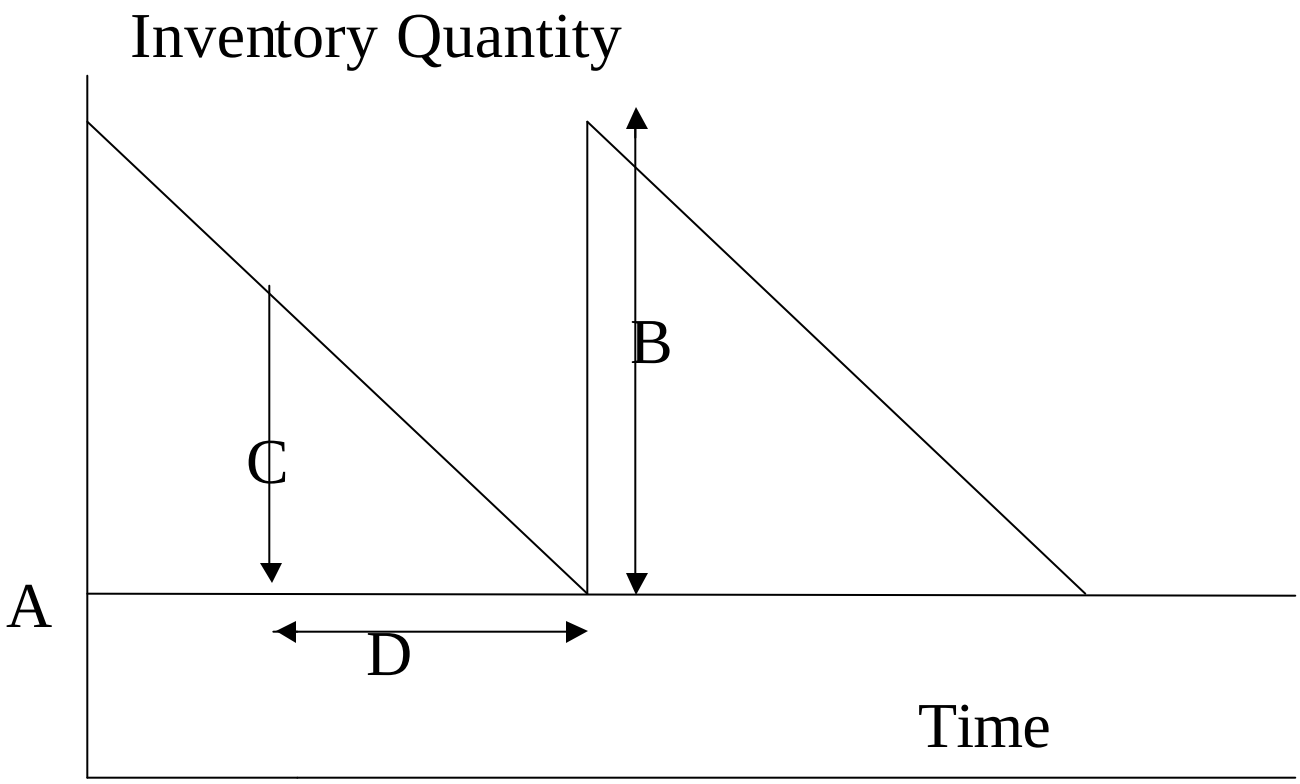
b. Inventory Reduction

Carrying chemical materials in the inventory is a complicated concern for management. Just in time acquisition reduces the huge infrastructure investments by eliminating excessive space needs to store excess chemicals. The savings could be substantial. Spare parts or typically non-chemical materials are much easier to store with simpler storage requirements than chemical materials. But the situation compounds in storing chemical materials, which require additional features in the storage area, including air conditioning, chilling room, etc. The materials also require enough room for sufficient ventilation. As a result, JIT procurement precludes huge infrastructure costs and reduces redundant investment requirements**.**

c. Shelf-Life Expiration

Cost incurred due to shelf-life expiration is a typical problem confronted in huge inventory carrying facilities. It is a byproduct of a push type of production concept. This contingency in chemical material inventories increases the likelihood of shelf-life expiration.

Traditional Procurement Concept



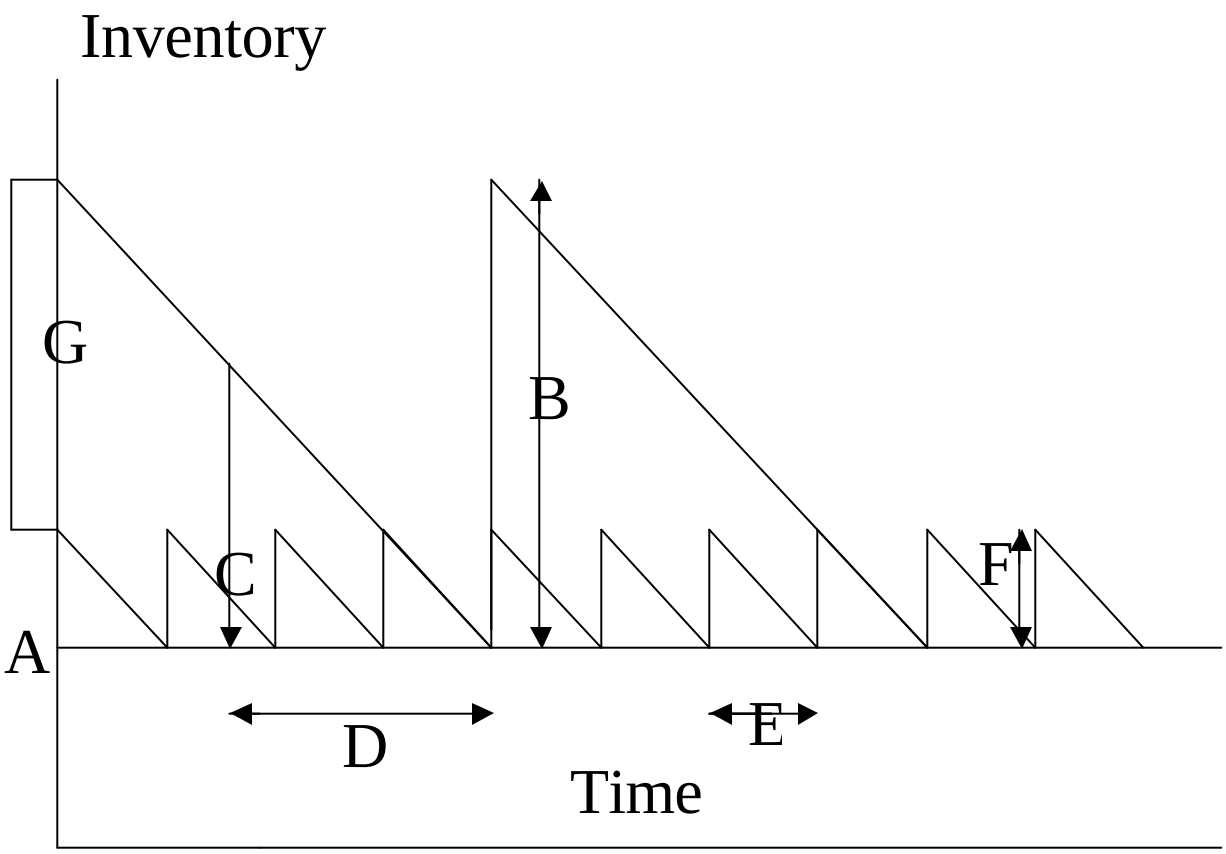
A: Minimum Stock Level
B: Order Quantity
C: Order Processed
D: Admin+Procurement Lead Time

Table IV. 1 Traditional Procurement Concept

In traditional procurement concepts, large order quantities are pervasive. To ensure not going below the minimum stock level and incurring stock outages, orders are processed relatively early to overcome lead times. Obviously, the traditional procurement concept provides quantity discounts, and decreased insurance and

transportation costs. However, materials wait in the inventory for a long time and inventory carrying costs, shelf life expirations, testing costs and chemical material deteriorations emerge as side effects.

Just In Time Procurement Concept



A: Minimum Stock Level
B: Order Quantity
C: Order Processed
D: Admin+Procurement Lead Time
E B: JIT Admin Time
F: Delivery Quantity
G: Eliminated Stock

Table IV. 2 Just In Time Procurement Concept

In JIT procurement, there are frequent deliveries with decreased quantities. Procurement lead time is shorter than under a traditional procurement concept. Even though insurance and transportation costs are higher than under the traditional concept due to an increasing number of processed orders, the life cycle cost of chemicals is reduced substantially.

Under the traditional procurement concept, as the turnaround time stretches, the likelihood of chemical shelf-life expiration rises. Simply the chemicals wait in the inventory longer before they are consumed. The FIFO (first-in-first-out) inventory technique attempts to overcome this situation. This technique is based on releasing the material sequentially. Whichever material has the oldest purchase date is released first upon a request from the user. The concept is typically applied in push type production facilities. Even though the FIFO concept engenders substantial improvements, it still has flaws, particularly with chemical materials. First, the system requires workforce attention. It works as long as inventory personnel pay close attention. Secondly, among chemical materials there might be different lifetime periods depending on the production lot. For various reasons, a group of chemicals procured before a second group might have a longer shelf life. Even so, the second group won't be released until the first group is depleted.

With the possibility of shelf-life expiration, a traditional purchasing model is two-fold detrimental; the sunk cost of the wasted chemical and the disposal cost. Moreover, if the chemical is a type II chemical, then testing costs become significant. All these steps drive up the life-cycle cost of the chemicals.

Just in time procurement addresses the problems. Presumably chemical material brought into the production site will be consumed in a relatively short period of time. This makes the unique features of chemical materials irrelevant and shifts some potential risks, like shelf-life expiration, storage, and stowage requirements, onto the supplier. As long as suppliers bring usable chemicals to the site, they will be compensated. Theoretically and practically, JIT procurement not only eliminates shelf-life expiration of chemical materials but also reduces chemical waste to a negligible level.

As a side effect the unit cost of a chemical procured under a traditional model would be less than the same chemical procured under the JIT procurement concept.

In contrast life-cycle cost of a chemical procured via JIT acquisition strategy would be far less.

Even though it makes some people feel uncomfortable, reducing the supply base is a core competency in Just-in-Time procurement. A certified supplier reduces the inherent risks that are likely to be confronted with many suppliers in a traditional buyer-vendor relationship. On the other hand, frequent deliveries might increase the chemical material costs due to transportation and handling costs. Flexibility in sources is as critical as on-time deliveries. Therefore aggressive attempts to reduce the supply base to one supplier might increase the risk in material costs and cause delays in deliveries. For instance, to obtain scheduled deliveries, the company can engage with four suppliers on a regular monthly basis. Each supplier is designated a delivery week in a month and every supplier pursues a delivery loop. This helps each supplier organize its delivery and production schedule and excess shipment costs can be prevented.

d. Supplier Base

Risk reduction in Just-in-Time procurement depends exclusively on supplier organization.

(1) Location Of Suppliers. By and large, the suppliers are located conveniently to the buyer company, which has established JIT procurement. This decreases shipment and handling costs. In terms of chemical materials, short transportation durations reduce the exposure of the chemical material to any outside risks, including improper temperature fluctuations, spills, packaging damages, etc. Yet convenient location does not necessarily mean short distances. Access to railroads, ports, and major highways are also enablers for frequent shipments**.**

(2) Supply Base Coverage. It is important how many items a supplier can provide at a time. The opportunity to bundle requirements reduces in administrative lead-time as well as administrative costs associated with the procurement. On the other hand, excessive bundling might not yield as much as the management thinks. Ability and capacity of a supplier should be overseen and taken into consideration. Overuse of bundling can obviously increase material costs when it is pushed beyond a supplier's capability. Strong alliances with the suppliers eliminate high chemical cost risks associated with paperwork, unnecessary procurement workload, delays etc.

(3) Quality Considerations. JIT procurement has an intense emphasis on reducing of the number of defects per each delivery. JIT procurement requires interdependent cooperation between the buyer and the supplier. Frequent and small quantity deliveries obviously put a demand on defect-free supplies. The necessity to comply with requirements improves shelf-life considerations and leads to a reduction in unwanted chemical waste due to delivering shelf life expired chemicals.

e. Barriers

Notwithstanding aforementioned risk reductions, JIT procurement is not easy to implement. It requires intensive management engagement in the production processes. In contrast to traditional methods, any failure, time lag or mismatches in JIT procurement shuts down the entire production, resulting in lost revenues for the company, as well as law suits.

One other issue is a widely accepted belief that JIT procurement entirely eliminates chemical waste. This is not true. Chemical scraps, byproducts, and disposal emanating from a production process are still inevitable in JIT procurement; JIT procurement does not change the machine sets. It only aligns the chemical requirements with the production line.

Moreover, the company's accounting system must be aligned with the JIT procurement concept. Prompt payment is the core issue in JIT procurement. Terms and conditions regarding quality considerations, flexible quantity deliveries, long term agreements, lead-time reduction, a desired level of performance and precise on time deliveries need to be negotiated up-front to eliminate any future uncertainties.

The company should organize itself for JIT when it starts production to maximize the saving opportunity. Otherwise, modifying the facility requires additional expenditures. Switching to JIT may create excess capacity in the facility.

2. Electronic Data Interchange (EDI)

> Electronic Data Interchange, commonly known as EDI, is the computer-to-computer exchange of business documents in a standard electronic format. (Ref. 45)

EDI use has increased in recent years and is a rapidly spreading technology in every business sector, and among chemical material consumers. Economies of scale, massive improvements in information technology and software engineering have helped

reduce the implementation costs needed for EDI. Therefore, more and more companies are implementing EDI features every day.

Under a traditional, paper-based procurement facility, a typical procurement process, in which Company A is the buyer and Company B is the vendor, would proceed as follows.

1. Company A creates a purchase order.
2. Company A sends the purchase order by fax or via mail. (Some orders are transmitted via the phone.)
3. Receipt of purchase order at Company B.
4. Order desk at Company B inputs purchase order into their system.
5. Company B warehouse receives a copy of the purchase order. (Either internally through the computer system or a paper based system.)
6. The warehouse packages the order.
7. The company B shipping department generates the shipping documentation, including an advanced shipping notice that needs to be faxed or mailed to Company A.
8. Goods leave Company B warehouse for Company A.
9. Goods are received at Company A; receipt of shipping is signed and sent back to Company B.
10. The company A shipping department sends all documentation to their payments department so that a check can be sent to Company B. (Ref.45)

The difference between EDI and the traditional paper-based process is in steps 2,4, and 5. With EDI the purchase order is sent via electronic means and processed in the vendor's system automatically. Therefore, it accelerates the process in step two and eliminates the necessity of entering received purchase order in the vendor's database.

First implementation of EDI goes as far back as the 1960s. Its diffusion has been highly correlated with the improvements in information technology. Approximately 50,000 companies in the United States are currently EDI users (Ref. 45) and 80% of fortune 500 companies are conducting procurement through EDI (Ref.10). The astonishing numbers depict how widespread it has become.

a. Core Competencies

EDI has been widely used in procuring chemicals. The core competency of EDI is reducing procurement lead-times in meeting customer needs. The customer can put a purchasing order in process when a requisition comes to the procurement department and the vendor receives the transaction immediately.

The benefits that EDI provides are compatible with the objectives of a chemical material user company looking for profit maximization. Conceivably, EDI addresses the inherent concerns on overall cost reduction in the private sector. The potentials are virtually the same for any kind of raw materials required for the production.

With its unique features, like shelf-life expiration and inherent chemical hazards, chemical materials are different than regular raw or value added materials needed for production. Yet the use of EDI reveals that even in the chemical industry EDI targets cost savings mainly by eliminating the procurement lead time, reducing inventory and speeding customer deliveries.

As long as the company frees up resources that have been tied up on required inputs and reduces its inventory, the cost of production can be brought down substantially. This objective automatically wipes out the far-reaching detrimental effects of carrying chemical materials. Presumably shelf-life expiration cases are minimized, because the risk has been reduced by eliminating huge inventories.

Mostly inventory is perceived as physical goods stored in facilities. However, the pipeline inventory is another high cost issue for companies. The chemical flow from the vendor to the buyer constitutes another inventory of chemicals. Paper-based procurement activities tend to involve more saturated pipeline inventories due to information lags between the vendor and buyer. Companies can enjoy pipeline inventory reductions provided by EDI with accelerated transactions. Moreover, chemical material waste occurring among the chemicals waiting for use in inventory is mitigated to negligible levels.

b. Accuracy Of Purchasing Order Information

EDI eliminates double entry attempts for purchasing orders. Entering the data manually by the vendor's workforce into the vendor's data system must reprocess the paperwork received by the vendor. Errors involving quantity, wrong item description or

even destination are likely to occur. These errors result in time and money losses. They might lead to wrong decision-making processes as well. Unnecessary batches might be run for production. EDI eliminates the duplicative efforts of purchasing order placements. Once it is entered into the buyer's system, it is automatically processed through the vendor's database.

Traditional systems operate on an error-detecting concept. Errors are corrected when discovered. Yet it is generally too late to compensate the losses occurring due to inaccurate data entry. Most of the time the buyer reports the error when the delivery is received.

Chemical materials compound the losses. If the chemical has a relatively short shelf-life, the material faces unnecessary deterioration during transportation and reshipping. Then the vendor has limited options; either store the material in stock or resell it to another customer. Should the company have the opportunity to redirect the chemicals to another potential buyer, the risks associated with shelf-life expiration can be reduced. Storing the material in inventory is riskier. There are two consequences to storing the chemical, assuming the chemical was not immediately resold. First are the inventory carrying costs that would be incurred, the other is the disposal costs of the chemical if the chemical's shelf-life expires, or testing to extend the shelf-life.

The noteworthy point is almost all aforementioned risks are born by the vendor, but indirectly affect the buyer. The costs are rolled into final product prices. That is why EDI requires trading partners and is worthless when only applied by either the vendor or the buyer. Even though the risks are supposedly born by the vendor, implementing EDI allows the savings received by the eliminating such risks to be shared bilaterally between the vendor and the buyer. Increased accuracy of purchase orders reduces the material costs and provides lower price quotes; the buyers enjoy reductions in price offers.

c. Reduced Mailing / Transaction / Administrative Costs

Rarely calculated, procuring chemical materials incurs administrative costs as well as the material costs. While the vendor's administrative costs or overhead costs are incorporated in the chemical's mark-up price, the buyers tend to ignore their administrative or overhead costs associated with a particular procurement activity.

Administrative costs or overhead costs can be substantial and implementing EDI can even be justified based on significant reductions in administrative and transaction costs. The saving potentials are amazing, particularly for larger companies buying significant quantities of raw materials.

d. Decreased Paperwork / Transaction To A Paperless Environment

Not all paperwork can be eliminated. All documents that are mailed or faxed could be transmitted electronically. This is an excellent opportunity to implement a paperless environment. Reduced paperwork brings efficiency and potential cost savings to the company as well as speeding the transaction between the buyer and the vendor. These cost savings are definitely reflected in the price of chemicals purchased. The document losses are theoretically and practically eliminated. So are the duplication needs for the lost documents. EDI has the potential to reduce non-value added steps in the process.

e. Accelerated Decision Making Process

Management is the core issue in conducting any kind of business with the desired efficiency and effectiveness. Timely and sound decisions are what management competency requires. EDI addresses this high-risk management process. Accurate and timely information is crucial for management to reduce the inherent risks in the decision making process. EDI moves information quickly, making it available for business decisions regardless of where the information is generated. Geographical distances do not impede activities when EDI is used. No matter how far the buyer and the seller are seperated geographically, information is timely and accurate.

This gives latitude to both the buyer and the seller. Detrimental consequences can be seen easily and precautions can be taken instantly. Not only does EDI give timely information, it also has the potential to enhance information accuracy. Management can focus on the exact information they want.

f. Inventory Reduction

The buyer can inform the seller instantly on what and how much to buy and when that particular chemical is needed. Thus the buyer reduces inventory costs based on particular contingencies inventory; chemicals are delivered on an as-needed basis. Inventory reduction is one of the highly appreciated management initiatives. In terms of

chemical materials; the case is more sensitive and cost savings may soar exponentially. EDI is extremely compatible with Just-In-Time procurement.

The speed in transactions enables companies to make purchases just before their actual use, while eliminating the need for permanent or temporary storage. The buyer does not need huge storage areas. This decreases further infrastructure needs and eliminates potential losses associated with stock piling chemical materials.

Presumably the vendor does not produce the chemicals on a forecasted future demand, but rather on actual purchases identified via EDI. Thus, vendors can get the actual demand faster and more timely. They can decide how much to produce and arrange the production line efficiently. Consequently shelf-life expiration and retesting for shelf-life extensions can be eliminated. Moreover, chemical material disposals are theoretically eliminated. The vendor can optimize production based on instant information on actual buyer demands.

3. Long-Term Contracts

A long-term contract is a contractual relationship and a long term alliance between the buyer and the vendor to deliver supplies or services. Long-term contracts have been used and enjoyed by the chemical industry for a long time. Two unique features characterize long-term contracts: one is volume based and the other is time based.

Typically, long-term contracts cover multiple deliveries and last for relatively long periods. Often these two characteristics are misinterpreted. A contract delivery can be spreaded through two or more cycles due to a variety of reasons. The entire volume may not be initially produced, or either the vendor or the buyer may currently lack transportation means necessary to transport the entire delivery all at once. In terms of time, the performance in a contract may extend to several successive years. Building ships generally requires more than a year. The shipyard can award all the chemical material needs to a contractor under the premise that the entire delivery of all line items is to be correlated to the shipyard's schedule to build the ships, and completing the contract may extend to more than a year. Even though this situation demonstrates multiple deliveries that last more than a year, it is not a long-term contract.

a. Risk Reduction

Long-term contracts enable both the vendor and the buyer to mitigate the inherent risks in procuring of chemical materials. Both sides get rid of traditional adversarial types of buyer-vendor relationships and replace it with a contemporary collaborative approach.

In a traditional sense, a contract is a one time action. Both sides engage for a relatively short time and the focus is on the short term. Rather than endeavoring to eliminate the risks associated with the procurement process, both sides attempt to shift any kind of business risk onto the other side. Obviously each side builds up contingencies in the agreement to preclude unfavorable consequences. As a result the material price goes up.

In the short run, allocation of resources to mitigate the risks may not seem as efficient as shifting it directly on your counterpart. However this outlook may lead to a win/lose or lose/lose type of contractual agreement. The outcome may not necessarily mean a total or potential loss to either side. Yet aggressiveness pursued by each side to maximize individual objectives can make it seem so. If the vendors assume the most risk, they are definitely going to reflect it in their marked up prices by increasing their profit premiums. In terms of chemical materials, the buyer can assume risk by buying excessive amount of chemicals under the premise of economies of scales. Obviously the price per unit will go down. However, the buyer bears the burden of carrying a huge inventory and may incur costs due to shelf-life expiration and retesting or unnecessary disposal.

In long-term contracts, it is more like a win/win contractual relationship. Both the vendor and the buyer allocate their resources to reduce the risks rather than attempting to shift them to their counterpart. Actually, both sides work for their own good, but also benefit the other side.

> J. Ronald Fox has described the thrust behind long-term contracts as follows Extra-contractual considerations dominate over profit or fee. A contractor rarely seeks to maximize profit during the short run of a single contract. He is more interested in taking actions that will expand company operations, lead to increased future business, enhance company image and reputation, benefit his business, or relieve such immediate problems as loss of skilled personnel and a narrow base for fixed costs. (Ref. 54)

b. Reduction Of Procurement Lead Time / Administrative Costs

Every time a company buys chemicals, preaward activities incur administrative costs and require time. The procurement personnel repeat the same course of actions; solicit quotes, do market research, go through a source selection process etc. These activities increase the overhead costs of the buyer and increase procurement lead-time as well. Not only does it increase the true costs of purchased chemicals, but the procurement activity also impacts material delivery lead time.

In long-term contracts, the supply base size is reduced and expenses associated with administrative efforts are mitigated. The vendor also sheds frequent rebidding expenses, administrative and marketing costs. In a long-term contract, vendors guarantee a long-term steady sale. Therefore, they may be willing to forego a portion of profits and quote more competitive unit prices.

c. Reduction In Market Price Uncertainty

One of the reasons that favors long term contracts is reducing price risk associated with future uncertainty. Fluctuating material costs are crucial and threaten the profitability of companies. Therefore companies aim to lock in relatively low material prices and take advantage of economies of scale by buying excessively. While this is perceived as a risk reduction method in terms of material costs, eventually, the company starts to incur costs due to inventory carrying and material obsolescence. In the short run, the buyer can enjoy relatively low material prices, but in reality it does not reflect the true costs of materials procured. Inventory carrying costs and administrative costs will eventually appear on another balance sheet account.

In a long term contract the buyer can stabilize the material costs. The buyer does not necessarily pay the same price for each particular material continuously; that would pose potential risks for the vendor. Obviously the vendor becomes vulnerable in such a case. Rather, long-term contracts protect the buyer from severe unstable fluctuations that may occur in the markets. That may seem a disadvantage to the vendors because they look like they forego the opportunity for potential market price increases. On the other hand, locking in current price advantages over the long term gives a competitive edge to the buyer (Ref. 41). However, that kind of an approach appears to be more like an

adversarial type of relationship and hinders the potential savings that both sides can enjoy in the long run.

Long-term contracts enable the buyer to hedge against price uncertainties. Meanwhile, the vendor guarantees a certain amount of sales, and therefore can reduce the risk to cover the immediate business costs. Moreover, the vendor can make investments to improve production efficiency. Associated cost savings could be passed onto long-term partners.

d. Improvements

Long-term contracts provide cost reductions due to cooperation between the buyer and the vendor. It can be regarded as a value engineering approach. Chemical materials are mostly considered as commodities in the markets. Therefore, possible improvements lie in management, production processes, plant layouts, computer-aided production and procurement process improvements.

It is worth noting that long term contracting is highly impacted by the management expectations on possible cost reductions. The improvement rates must exceed a certain limit to justify the investments necessary for the improvements. Such investments require up-front fixed costs. The chemical seller would have to consider the length and terms of the contractual relationship prior to making capital investments.

There are arguments that object to long term contracting in terms of the tradeoffs between improvement rates and fixed investment costs (Ref. 13). The argument suggests that if the improvement rate is low and the fixed investments are high, it is not optimal to use a long-term contract at all. That is potentially one reason why managers are slow to invest in long-term contracts.

The argument may have merit at the first glance. However, an in depth analysis demonstrates broader benefits. Potential improvement rates might be low and might not entice management to make the investment. Yet this situation does not necessarily mean that the long-term contract is not optimal. What is not optimal is the investment itself. The buyer can still enjoy cost reductions and reduced procurement lead times in a long-term contract. Even though long-term investments are beneficial to both sides, they are not necessarily required. Besides, all investments do not stipulate huge

capital investments. Eliminating non-value added steps reduce administrative costs substantially and bring down material costs.

e. Designing Long-Term Contracts

Constructing a long-term contract requires close attention. It is not a one-shot market deal, rather it develops a long-term relationship with a reduced supply base. That is why the contractual agreement should incorporate more than a cost based short-term outlook. This dictates mutual cooperation and strategizing a long-term vision that favors periodic bilateral negotiations when necessary. Unconditional compliance with the contract does not help reduce the risks but increases uneasiness and discomfort on both sides. Hence flexibility to terminate the agreement must be included in the contract. Clarifying the conditions to terminate the contract prevents building contingencies into contract terms and conditions.

During the course of the contract, cooperation is the facilitator to fill the gaps due to emerging contingencies. A mutual teaming effort helps to make cooperative decisions and optimizes the allocation of resources to eliminate uncertainties. Though the teaming effort, shared body of knowledge and information is developed. This enables both sides to respond to new conditions and accelerates the decision-making process as new problems emerge.

The contractual agreement should appreciate reciprocal access to gathered information. Information exchange about markets, expectations, and forecasts on the economy or a particular sector may help to ease uncertainty. Either side can preclude wasting duplicative resources to get the same data.

4. Market Research

Market research is an extremely powerful key to reducing future risks and uncertainties.

By simple definition, market research in this thesis is "…the process of garnering, purifying, organizing, analyzing information regarding the markets to gain or sustain a competitive edge in the business segment that a company operates."

In the private sector, companies seek to obtain the following via market research:

- Increased Competition
- Lower Prices

- Better Negotiation Strategies
- Strategic Positioning in the Market
- Improved Quality
- Identification of New Sources

These aforementioned topics are the immediate or far-reaching results of market research and may vary across companies.

The common outcome that emanates from a properly conducted market research program is risk reduction in the decision making process. Because a company does not generate or have all information that delineates the markets at a given time, neither theoretically nor practically there is a way to entirely eliminate market related risks. Yet market research can reduce risks and facilitate flexibility and accuracy in decision-making. Eventually the decision made or the action taken leads to lower prices, increased competition etc.

Management tends to have flexibility and enough room for decision making when problems arise. Information enables companies to be responsive to the changes in the environment. Time lags and lapses diminish the positive impact of the actions taken or decisions made. Therefore, companies strive to gather information through market research.

Market research is composed of two parts. One component is market surveillance and the other is market investigation. Market surveillance focuses on general industry trends, practices and events. There is not a particular information target but rather a superficial outlook for the industry. On the other hand, market investigation targets a specific information objective, and is more detailed in comparison to market surveillance.

The aforementioned description is for the purpose of simplicity in understanding the market research structure. In reality there is no such segmentation of market research in the private sector; neither as a description nor as an approach. Market research is an ongoing process and both components are highly integrated. One has less value without the other.

Market research can be confused with Marketing Research. Marketing research is associated with selling services or products. In contrast, market research focuses on the markets in which a company supplies its products and services.

The distinction deserves close attention when delegating the market research task and the associated resources. Market research is conducted by the procurement department while marketing research is conducted by either the marketing or the sales department. Empowering the marketing or sales department to conduct market research has consequences in that the information derived from market research is utilized by the procurement department; it is useless for the objectives of marketing department. Consequently, the sales/marketing department would be ignorant on market research and earmarked funds would be committed for irrelevant purposes. Even if satisfactory and necessary market research is conducted, it necessitates transferring the information to the procurement department. In the course of transfer, time lags, misdirection, information loss and duplicative efforts are inevitable.

a. Market Research Areas

The objective of market research is to reduce uncertainty and enhance management decision-making by management. There is no established theory of market research, nor are there any comprehensive, "one size fits all," cookbooks. It is highly driven by market characteristics, company culture, business environment, etc. Even in financially strong and secure companies, resources in terms of time, funds and personnel are limited. Hence the procurement department must optimize its efforts to gather the targeted information with the least investment.

Market research is conducted in various areas.

- Price / Cost Characteristics
- Suppliers
- Availability
- Quality
- Legal (Laws, Regulations)
- Data Flow
- Economic Trends

The information derived grants a general stance on relevant areas that directly or indirectly effect chemical material procurement. It does not address specific information.

Any specific decision-making that is subsequent to the information gathered on one of those areas carries substantial risks. Management should look for more detailed information on that particular subject. This type of market research can be used to delineate the long-term visions, engender company policies, etc.

b. Market Research On Chemical Materials

Market research on specific chemicals is much more detailed and demands close attention. Even though there are some specific areas affiliated with chemical characteristics, most of the areas below can be considered almost the same for commodity materials.

1. Make vs. Buy Considerations
2. Method of Production
3. Follow-up-Services
4. Packaging
5. Transportation
6. Substitution
7. Compliance with Current Laws / Regulations
8. Scrap/ Disposal
9. Recycling Opportunities
10. Shelf Life
11. Obsolescence Rates
12. Material Handling / Storage
13. Safety

c. Market Research On Vendors

Market Research on vendors is as necessary and essential as in the chemical itself. Recent business practices do not regard vendors as enemies, but rather as critical partners. Vendors with good credentials improve the performance and positively affect future business opportunities; the reverse may have costly consequences. As a matter of fact, market research information on vendors is utilized when making decisions on sourcing and contracting. Market research on vendors considers:

1. Financial Status
2. Production Facility

3. Minimum Production to Breakeven
4. Maximum Production Capacity without Fixed Cost Investment
5. Manufacturing Costs
6. Pricing Strategy
7. Public Image
8. Past Performance
9. Company Culture
10. Source of Supply
11. Marketing Strategies

d. Market Research Sources

Nothing restricts the market research sources unless they are unreliable. Unreliable sources might misdirect the company and waste resources. Typical market research sources are:

1. Internet
2. Procurement Personnel (Particularly in the same business segment)
3. Sales Personnel
4. All Relevant Publications
5. Commercials
6. Chemical Affiliated Organizations
7. Consulting Firms
8. Trade Journals
9. Industry Associations

Provided that it is competently and consistently used, a company can harness market research to mitigate risk in chemical material procurement

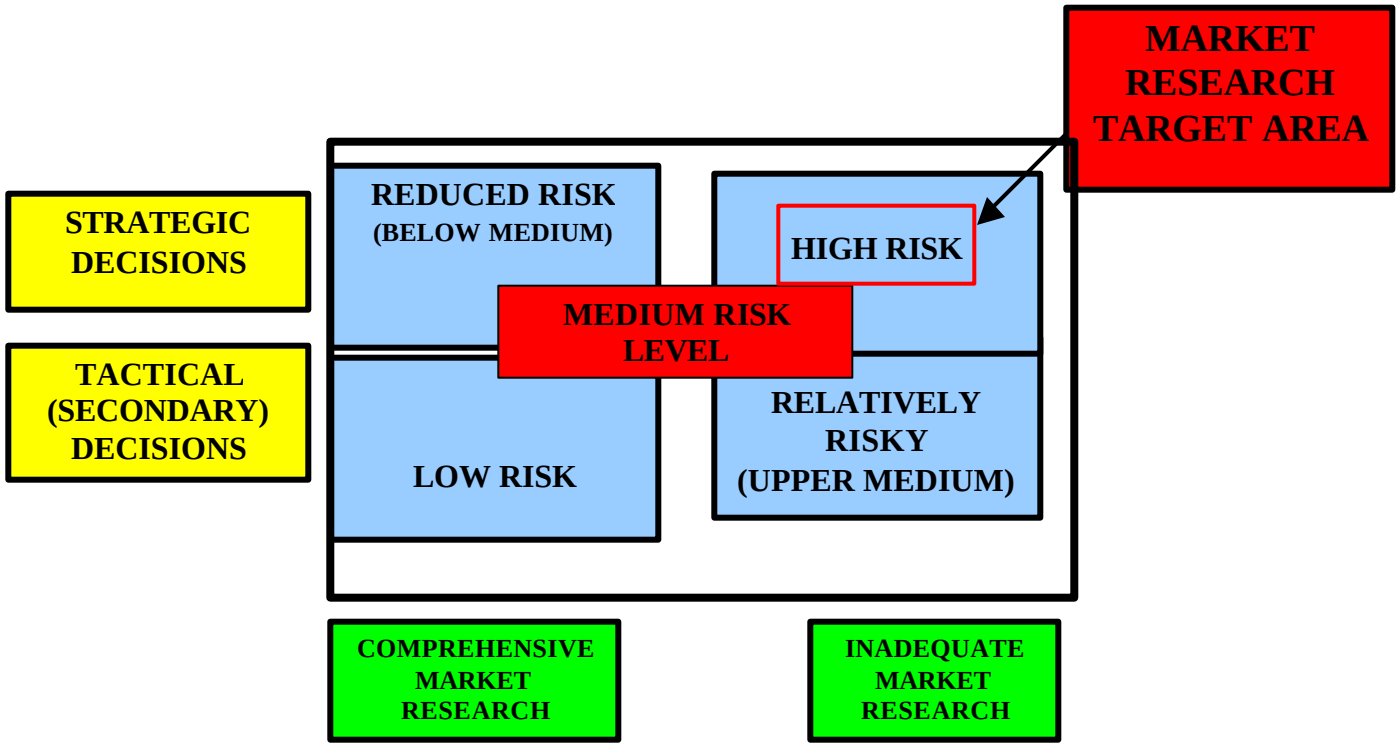


Table IV. 3 Market Research Target Area

The level of market research conducted depends on the consequent risks of the management decisions on chemical procurement. As long as thorough and comprehensive market research is conducted, associated risks are reduced. The desired level of market research rests on three main factors: when is it done, who conducts it, and what kind of information is sought?

First information has the highest importance when it is timely. As time passes, it loses its effect. Therefore, market research should engender the requested data on time to enable management to make the best decisions. Time lags or lapses can make those actions fruitless and not affect the risk affiliated with the procurement decisions. Timeliness of market research is a critical factor in risk reduction.

Secondly, skilled and experienced procurement personnel should be engaged in the process. An interdisciplinary approach, which involves trained personnel in

related fields, increases outcome quality. It is rational to require chemical engineers as well as people with business backgrounds to perform market research. Presumably people from different disciplines analyze the raw data to the maximum extent possible. People without the appropriate background can fulfill the data collection requirements, but would provide lackluster performance in analyzing the raw data. To perform quality market research, a skilled and experienced workforce with relevant education should be designated.

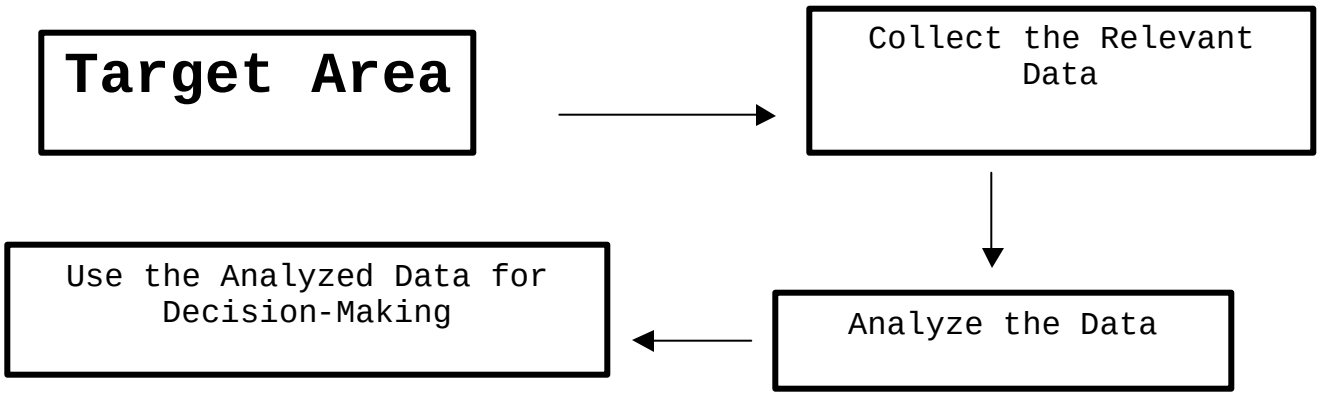
The third main point is the objective or the target area on which the market research concentrates. Procurement personnel should be cognizant of what is sought. This should be decided up-front, before the market research is started. Defining objectives prevents wasted time and inefficient resource allocations. For instance, market research on the past performance of a supplier can be derived from consulting firms, the chamber or the organization in which that vendor participates. On the other hand, sales personnel of the vendor are almost a useless source of market research on the vendor's past performance and can easily undermine objectivity.

In fact, it is not the quantity but the quality of market research that determines the level of risk reduction. Collecting any kind of information without being selective gives management useless information. It even becomes harder to filter information to achieve a sound decision. This not only inhibits management, but wastes limited resources.

Market research personnel should decide where best to invest the resources and what kind of market research is conducted on what. Market research efforts are directed on the subjects that are likely to influence strategic decisions. Prioritization of targeted market research areas leverages resources and optimizes resource allocation.

e. Market Research Cycle

The following chart demonstrates the steps in a market research cycle and targeted objectives in each step.



Target Area	1. What is the requirement? 2. What are we looking for? 3. How urgent is it? 4. What is the deadline for information? 5. Allocate resources
Collect the Relevant Data	1. Is it what we are looking for? 2. The sources (Select) 3. What is enough?
Analyze the Data	1. Personnel from Related Fields 2. Teaming Approach 3. Does it make sense?
Use the Analyzed Data for Decision-Making	1. Can we see it more clearly now? 2. Are we satisfied? 3. Does it support the decision?

Table IV. 4 Market Research Cycle

5. Chemical Management Services (CMS)

Chemical Management Service (CMS) is a strategic, long-term relationship in which the perception is not selling chemicals to a buyer but rather managing the customer's chemicals and any kind of process affiliated with chemical materials. Even though the concept might seem new, business has been using the tools to implement CMS for a long time. CMS is a hybrid form of performance based services and value engineering.

CMSs have transformed the way companies procure chemical materials. Chemical users have embraced the concept since the mid 1990s. This new trend has evolved simultaneously with the interest in performance based contracts and the public environmental concerns.

The thrust behind the concept is the huge costs associated with the chemical materials life cycle. On top of the procurement costs, companies incur extremely burdensome costs when processing, carrying and disposing chemical materials. Research conducted in this area demonstrates that per each $1 worth of chemical material procured generates from $1 to $10 in additional costs (Ref. 50). These costs are often incurred for

- Procurement Administration
- Market Research
- Inspection
- Inventory Carrying
- Infrastructure Investments
- Scraps, Spillages
- Chemical Obsolescence
- Waste Disposal
- Compliance with Environmental Requirements
- Training, etc.

A facility consuming $1M worth of chemical materials might spend from $1M to $10M throughout the chemicals' life cycle depending on how efficiently and effectively the company works. This is an obvious risk that can make companies lose their competitive edge. Often these costs are reported under different financial records than

chemical procurement costs. Even though it does not change the bottom line, the true costs of chemical materials are concealed. When management is uncomfortable with high chemical costs, the culprit is mostly high procurement costs. The targeted cost reduction is never achieved in that the management focuses on the wrong issue.

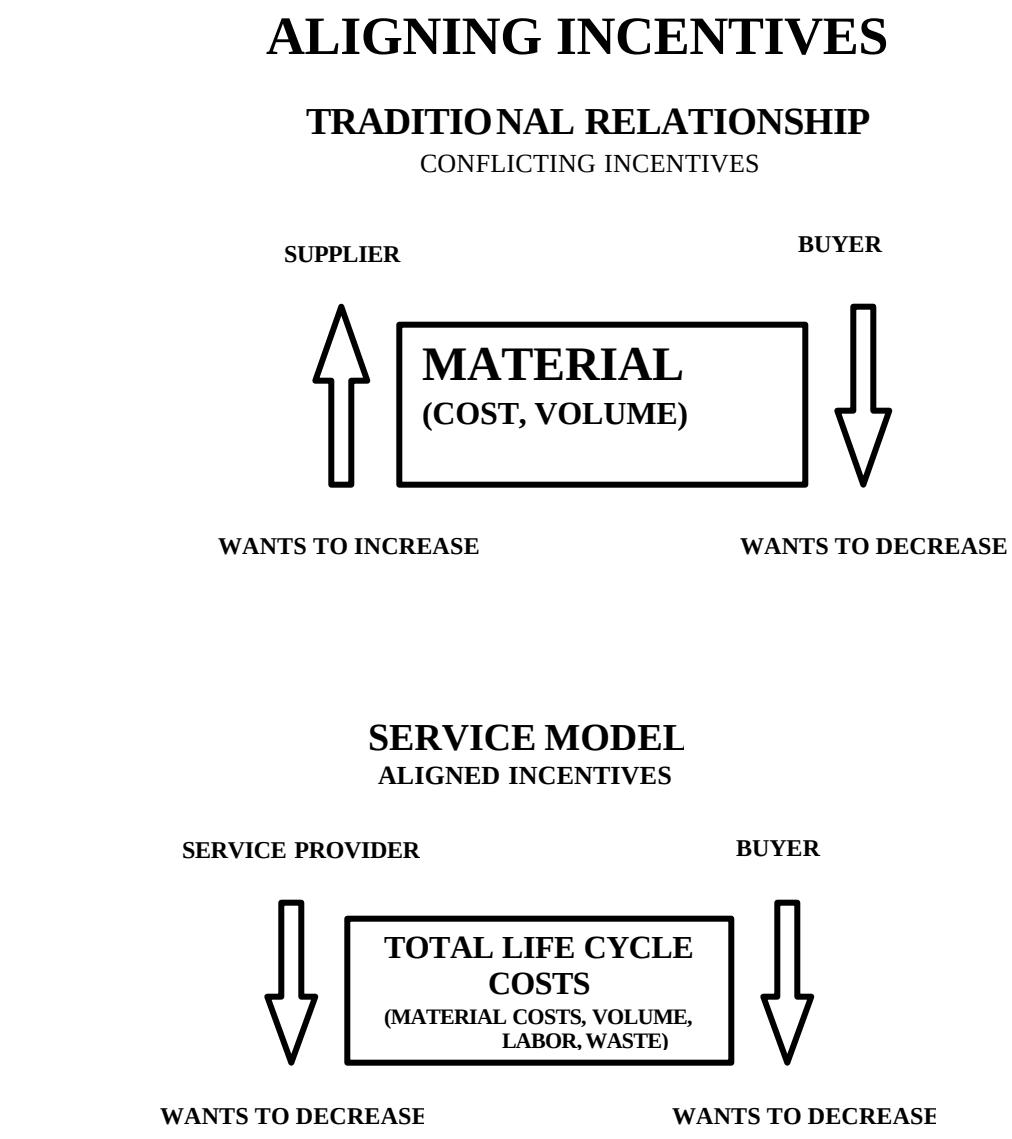
CMS growth is highly visible, particularly in the auto industry. It is estimated that roughly 50 to 80 % of the auto industry uses CMS as a tool in acquiring of chemical materials. Mass production, assembly lines are facilitators and enable the auto industry to implement CMS faster than other industries. Notwithstanding the poor penetration in other industries, some recent contracts indicate CMS is promising for other high chemical material consumer industries, like Aerospace. Increasing public environmental concerns and high costs seem to drive companies to embrace the CMS concept in acquiring chemical materials.

In the traditional way of purchasing chemical materials, there is an adversarial relationship between the vendor and the buyer. The vendors sell the better off they are; buyers endeavor to reduce the amount they procure. Even though some sophisticated information technology systems or JIT procurement struggle to solve this adversarial type of relationship, they have not been entirely successful. The benefit of implementing these systems or concepts is reducing human intervention or curtailing the procurement lead-time.

Conversely, under a CMS contract, the supplier is not compensated on the volume of chemicals provided. Delivering and managing the chemicals across the entire life cycle drive compensation. Therefore CMS does not merely focus on quantity but optimizing the processes without foregoing the desired quality of the end product.

a. Aligning Incentives

The CMS model strives to align the incentives to minimize the chemical use across the chemical supplier and the buyer.



CHANGE IN THE SUPPLIER COMPENSATION MODEL: THE SOURCE OF POTENTIAL ENVIRONMENT GAINS

Table IV. 5 (From: Ref. 27) Aligning Incentives

The buyer is interested in the end result. In the auto industry the goal is painting a car at the desired quality. With a CMS contract, the buyer does not stipulate detailed specifications, like how much paint must be used, or how or when the paint is applied. The buyer stipulates performance specifications or criteria that a finished product must meet. The buyer defines the objective; the means to achieve the objective is left to the supplier's discretion. In this way, the supplier is encouraged to be innovative and creative in meeting the customer's needs. Suppliers can invoke their experience, skillful workforce, knowledge or even joint ventures to streamline the chemical acquisition activities and reengineer the chemical material use or applications on the product.

Therefore the chemical management service provider has no incentive to increase the volume of chemical brought into the production facility. Given the specified level of quality, chemical materials are inputs that increase costs and reduce profit margins. The fewer chemicals consumed, the high profits. Both sides are now driven by the same incentive; reducing the volume of chemicals consumed.

b. Contract Design

Designing a chemical management service contract is the core issue in successfully applying CMS. A chemical management service has two dimensions that constitute the scope of the contract: service area and chemical range.

(1) Scope of Service Area. A chemical management service does not just outsource chemical procurement, but focuses on all activities, processes and consequences related to the chemical life cycle. The chemical life cycle includes:

- Market Research
- Planning
- Procurement
- Inspection
- Delivery / Transportation
- Inventory
- Use
- Disposal
- Compliance with Current Regulations / Laws

The chemical life cycle refers to the scope of the contract signed between the supplier and the buyer. The contract does not necessarily incorporate all areas. Services may include procurement of chemicals, maintaining inventory, providing just in time delivery, actual application or use of chemicals. The supplier can supply only one, some, or all of the services.

Theoretically, contracting out all services benefits the buyer to the maximum extent. All hidden costs, like overhead or direct administrative costs, can be easily seen and shifted onto the supplier. Thus the buyer can negotiate the true costs up-front and reduce the risks of encountering surprises. Moreover, it is very difficult to clarify the liability issues between the buyer and the supplier when some parts of the services are conducted by the buyer and some parts by the seller. Obviously there are some gray areas that might create conflicts when problems emerge in delivering the contracts.

Notwithstanding the promising features, a chemical management service might not incorporate all related fields and the buyer can still retain some services. The decisions on what should be left out of the scope are driven by the competencies carried out by the supplier.

(2) Chemical Range. Entities consume varying types of chemicals. A chemical service contract may include all or particular types of chemicals used by the facility. For instance, the service provider can manage lubricants and coolants, while adhesives are still managed internally. This decision is based upon potential returns on investment and relative strengths and weaknesses of each participant. There is diversity in chemical materials. Inspection, storage requirements, application and use difficulties differentiate chemicals from one another. The service provider may have expertise on lubricants and coolants, but may lack even preliminary knowledge about adhesives. The chemical management services concept concentrates on core competencies. Invoking a service provider blindly, without paying attention to core competencies definitely leads to detrimental consequences. A service buyer should consider what kind of chemicals to purchase from which service provider, or whether they should be provided internally.

c. Compensation Structure

Compensation for the service supplier can be designed to encompass various elements. It is critical to define the minimum performance specifications up-front, so the service provider will know what to achieve.

In the auto Industry, " Fixed Fee Per Quality Vehicle Painted" is a frequently used compensation method. Historical chemical usage to produce a car is taken as a benchmark. The service provider is required to deliver a quality product, focusing interest on the quality of the painting processes and the chemicals used. While the supplier can be paid mainly on a negotiated fixed price per product, continuous cost reductions per year can be built into the contract based on improvements in the processes and reductions in chemical material usage.

Because CMSs are performance-based services, innovation and creativity are likely to be invoked. It is critical to incentivize the service provider to improve performance and reduce costs. Sharing cost savings will definitely incentivize the service provider and benefit both sides. Some compensation structures used by industry include:

- Fixed Monthly Fee Based on Historical Chemical Usage
- Staffing Fee For Full Time, in Plant Support Personnel
- Sharing Large Financial Gains or Losses
- Rebates For Large Reductions in Chemical Usage
- Fixed Fee-Per-Unit Product
- Management Fees For Selected Services
- Materials Cost Plus Management Fee Based on Material Throughput
- Savings Sharing on Process Efficiency Improvements
- Service Fee
- Bonuses For Chemical Use Reduction
- Fixed Annual Fee For Chemicals That Are Not Correlated to Production Volume

Services that are provided with a Chemical Management Service contract are

- Chemical Acquisition
- Research And Improve Chemical Performance
- Monitoring Chemical Usage

- Inventory And Distribution Management
- Testing & Lab Analysis
- Process And Waste Problem Solving
- Waste Minimization
- JIT Delivery
- Process Optimizations
- Continuous Chemical Use Reductions

d. Risk Reduction

CMS contracts reduce costs, and time, and eliminate non-value added applications. These benefits can be articulated as follows:

- Reduction in Chemical Material Usage
- Increased Competition Among Suppliers
- Reduction in Chemical Waste
- Streamlined Processes
- Automation of Chemical Application Processes
- Improved Inventory Control
- Reduced Inventories And Inventory Carrying Costs
- Reduction in Supplier Base
- Reduced Re-work
- Improved Product Finish Quality
- Reduction in Shelf-Life Expiration, Material Obsolescence
- Reduction in Risk Insurance Payments
- Reduction in Purchase Orders

With substantial cost savings and reducing redundancies, a CMS contract contributes to a company's competitive advantage. It also reduces cost-related risks and risks related to workplace safety, company image and employee trust.

e. Barriers To Enter

It is clear that CMS benefits potentially outweigh the costs required to implement a CMS contract. Yet, due to its characteristics and its recent introduction to the business environment, there are some challenges that make it hard to implement.

In most companies the true costs of processing chemicals are unknown. The cost that is considerated is the material cost itself; often management does not consider the total costs associated with the acquisition, use, storage, testing and disposal of chemical materials.

The inherent disadvantage of a CMS contract is that it depends heavily upon economy of scale usage quantities. Management feels more confident using a CMS contract if the chemical materials are strategic to the company's business and profitability. There is sufficient room for innovation and creativity if chemical costs are significant. Every investment is made under the premise of return to investment, and, a CMS investment may not be justified in entities where chemical material use is not significant.

D. CHAPTER SUMMARY

This chapter discussed business concerns associated with the acquisition of chemical materials. It provided the methods used when procuring chemicals. Additionally, this chapter discussed various strategies used by industry to mitigate chemical material acquisition risks.

The next chapter will present the researcher's conclusions, answers to research questions, recommendations and suggested areas of further research.

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V. CONCLUSION AND RECOMMENDATION

A. CONCLUSION

The purpose of this study is to examine the Turkish Air Force's experience with the acquisition of chemical materials and assess the risk areas associated with chemical materials. The researcher concludes that the Turkish Air Force is operating at a reasonable effectiveness level. The reason that leads to this conclusion is the absence of critical chemical material shortages, which might have serious consequences. The inventory carries sufficient chemicals to make the logistics system responsive to emerging material needs. However, the efficiency level is questionable. Lack of necessary cost elements precluded measuring the life cycle cost of chemical materials to make more solid efficiency interpretations and comparisons.

From business point of view, this research summarized how business perceives chemical material acquisition. This research does not compare the practices in Turkish Air Force with business practices to decide which is superior. Rather, the research aims to identify different concepts that highlight potential improvements in Turkish Air Force.

It is obvious that the military and the business are driven by different objectives and operate in different environments. The rest of this chapter encompasses specific conclusions, recommendations, answers to research questions and suggested further research areas.

Despite the lack of the necessary cost data to measure the life cycle cost, the true costs of chemical materials is much higher than just the procurement costs. Recurring testing process costs due to shelf-life expiration, continuous purchasing in short shelf-life (under 1 year) materials compound the costs. Moreover the Turkish Air Force is not able to exploit economies of scale while procuring short shelf-life materials.

Business tends to see the chemical materials as commodities. Carrying chemicals in the inventory is not perceived as a risk reduction. Therefore, business strives to reduce inventories and endeavors to shift inventory related costs onto suppliers. However, this approach depends on having reliable suppliers operating in the same environment.

The Turkish Air Force procures substantial amounts of its chemicals from foreign sources. This makes it difficult to implement promising business practices, which depend heavily on close buyer-vendor relationships and a reduced supply base.

The Turkish Air Force also lacks market information on chemicals. There is not sufficient information to draw conclusions about the capacity and capability of market forces to provide chemicals to Turkish Air Force.

Environmental aspects, chemical waste and disposal issues do not seem to be a large enough concern to alter current acquisition methods.

Carrying excess chemicals in the inventory increases costs. However, it also serves as a risk mitigation strategy to meet surge requirements. This need differentiates the Turkish Air Force from commercial business. The Turkish Air Force is not as aggressive as business when it comes to inventory reduction strategies.

Particularly in the chemicals procured via FMS, procurement lead-time is extremely long. Material consolidation efforts for transportation purposes compound the problem.

Absence of an adequate accounting system impacts the Turkish Air Force's ability to capture all costs associated with chemical material acquisition. Therefore the true costs cannot be estimated.

Absence of statistical information also hinders the development of models. For instance there are not any records available on which type of chemicals are likely to receive an extension upon testing.

NAMSA and FMS are seen as reliable sources with good delivery guarantees.

Testing 78% of the inventory for shelf-life extension is an indicator that more than necessary inventory is carried and there is substantial lag between delivering the chemical in the inventory and consuming it.

B. ANSWERS TO RESEARCH QUESTIONS

1. What is the Turkish Air Force's experience with the acquisition of chemical materials and how might this information be used to improve current acquisition methods?

This study concludes that Turkish Air Force is reasonably effective in meeting its chemical material needs. It has developed reliable sources and is able to fulfill its customer requirements. On the other hand, extensive shelf-life expirations are experienced

among the chemicals in the inventory. Even though a substantial percentage of the chemicals receive lifetime extensions, it is risky to depend on a shelf life extended inventory. Although cost data regarding extension tests is lacking, it is obvious that it increases the life-cycle chemical costs. Particularly in FMS and NAMSA procurements, the Turkish Air Force experiences unnecessary long procurement lead times. Adopting more commercial practices can overcome this problem. Reducing procurement lead-times can also reduce shelf-life expirations among idle chemicals in the inventory.

Consolidating chemical storage has been a wise step. It helps the Turkish Air Force leverage its resources to manage the inventory. Transactions between the inventory and the test lab are also carried out easily because they are located at the same site.

Chemical waste disposal is currently not a big concern. The underlying factor is that Air Bases leverage MKEK to dispose the chemical waste. The process is free and they do not incur any costs. Air Supply and Maintenance Centers, which hold an ISO-14001 standard, incur chemical waste disposal costs. However, it does not hurt the organization. Furthermore, they have been developing a comprehensive knowledge base on how to cope with hazardous materials.

2. What are the statutory/regulatory/organizational concepts associated with chemical material acquisition?

Chemical material acquisition is bounded by the following statutory / regulatory / organizational concepts:

- The Procurement Law (# 2886)
- The Environment Protection Law (# 2872)
- The Law On The Protection Of Competition
- The Notices
- MSY / 310-1 Acquisition Regulation
- ISO-9001 / ISO 14001

The Procurement Law (# 2886) and the Notices constitute the concepts and procedures governing acquisition. The Law On The Protection Of Competition does not stipulate specific requirements but rather provides guidance on acquisition procedures.

The Environment Protection Law (# 2872) addresses chemicals procurement. The Acquisition Regulation describes procedures to acquire chemicals from foreign sources.

Shelf life expiration, long procurement lead times, storage requirements and chemical waste disposal are issues associated with chemical materials.

3. What are the current issues, problems and potential risks associated with the acquisition of chemical materials?

The main problem is the shelf life expiration. Shelf-life expiration endangers operational availability and can lead to material shortages and testing costs, as well as inventory carrying costs due to over-stocking. Chemical material storages require special infrastructure investments due to unique features of chemical materials. Currently chemical waste disposal is not a big concern in Turkish Air Force. The opportunity to pass chemical waste to MKEK shifts the problems associated with chemical waste disposal away from the Turkish Air Force.

4. Currently, how does the Turkish Air Force mitigate the issues and risks associated with the acquisition of chemical materials?

Actually there is not a management policy in terms of acquisition of chemical materials in the Turkish Air Force. Therefore, risk management can be analyzed through implied risk management methods in the process.

Shelf-life expiration is frequently experienced among the chemicals in the inventory. A high percentage of the chemicals pass the extension tests and are granted lifetime extensions. This mitigates the potential material shortage risks and risks associated with reprocurement costs. Even though shelf-life extensions are not a direct form of risk mitigation in chemical material acquisition, the high percentage of shelf-life extensions prevents excess purchasing and stock outages.

Consolidation of requirements helps the Turkish Air Force exploit economies of scale to bring down unit costs. Furthermore, commercial sales are employed to shorten the procurement lead-time. However, shelf-life issues are not built in contracts or sources to prevent shelf-life expirations. Mil-specs are considered a risk reduction tool: The premise is that a mil-spec guarantees the desired quality in a procured chemical.

5. What are the current best commercial chemical material acquisition practices?

Electronic Data Transfer, Just-In-Time Acquisition, Long-Term Contracts, Market Research and Chemical Management Services are commercial practices that are employed widely. There are two common features of these practices: inventory reductions and alliance with the supplier base. Business is concerned about inventory cost reduction when implementing one or more of the aforementioned business practices.

6. Given the Turkish Air Force's experiences, how might they improve their chemical material acquisition practices?

Business practices focus on decreasing procurement lead-time and consequently inventories. The premise is that as long as the supplier can provide the materials on time; there is almost no reason to carry inventories. In the Turkish Air Force, most chemical material related problems are caused by long procurement lead times and excessive inventory. It is not viable for the Turkish Air Force to accept all business practices blindly in that both operate in entirely different environments. However, the Turkish Air Force can take advantage of business experience on supply base alliances, reduced procurement lead-times and reduced inventories.

C. RECOMMENDATIONS

- A risk management program for chemical material acquisition should be implemented in the Turkish Air Force. Policies and guidance on risk management help to identify problems and mitigate the inherent risks when procuring chemicals. A risk management program makes the procuring body proactive and preventive in the chemical acquisition process. Even when rotations or turnovers occur, new personnel can easily adopt the concepts. A risk management program will definitely encourage better performance and reduce the risks associated with chemical materials.
- Chemical procurement should be decentralized. In the current system, the user units do not have any incentives to streamline the acquisition process or to invoke innovative ideas. They are not even interested in the cost unless the user unit procures the chemical. If chemical acquisition is decentralized, the user units will be granted the necessary budgets. The ability to program the funds would incentivize the units to optimize their resources by being innovative and creative.

This could easily shorten the procurement lead times as well as reduce the unit costs. However, this endeavor can get some resistance from some units that consume relatively small amount of chemicals. The Turkish Air Force should seek a Pareto optimal solution in this case. If the total benefits outweigh the costs due to resistance, decentralization should be implemented. Consolidation of needs might address small user unit's requirements. On the other hand, decentralization should not be undertaken arbitrarily. Consolidation and centralization can provide substantial economies of scale, particularly on long shelf-life chemicals. This requires detailed and comprehensive research.

- Mil-Specs requirements should be relaxed if a chemical material has a commercial substitute with the required qualifications. For instance, adhesives might have substantial potential in this area.
- Commercial purchasing should be adopted by implementing commercial terms and conditions. Profit oriented contractors would be creative and innovative to deliver the chemicals in shorter periods. Payments are the incentives to encourage them to shorten the delivery process. FMS and NAMSA procedures obviously slow down the acquisition process. The noteworthy point in this issue is that the Turkish Air Force enjoys lower unit costs due to economies of scale in FMS and NAMSA procurement. Presumably procurement lead times can be brought down substantially. But the question is whether shortened procurement lead times justify the increased unit costs. To make a comparison, the true costs of chemical materials must be known, not just the initial acquisition cost.
- Implementation of commercial type JIT acquisition does not seem viable for the Turkish Air Force, because most of the chemicals are procured from outside the country. Without a doubt, sustaining close relationships with vendors is a necessity in JIT acquisition applications. Geographical distances would be a tough obstacle to overcome. Given the Turkish Air Force's knowledge about the chemical base of the country, comprehensive market research is a necessity on the capacity and capability of the domestic manufacturers that can support a JIT acquisition concept. Even if JIT acquisition is applied for particular chemicals, the concept should be employed on top of a reasonable emergency stock. A

commercial type application would endanger operational availability in case of a delivery problem or an unexpected shortage.

- Indefinite Delivery-Indefinite Quantity (IDIQ) type contracts would fit perfectly in chemical material acquisition. Particularly in relatively short lifetime materials (Below 1 year), testing costs and repetitive continuous purchases can easily be eliminated. Administrative costs and paperwork can be reduced substantially by eliminating contract preaward processes, also in shortening procurement lead-times. The Turkish Air Force does not necessarily repeat the same structured approach to award a contract if IDIQ contracts are implemented. This would also increase the contractor responsiveness.
- A value chain analysis is necessary to assess the value added steps in the acquisition process. The acquisition process is highly structured and there is not any room to keep up with the changing needs and improving environments. While conducting an acquisition with accelerated payments, some red tape and administrative requirements are eliminated. If this case does not necessarily impact the acquisition adversely or lead to undesired consequences, why not apply the same analyses to all processes. Re-engineering the acquisition process provides an opportunity to delete non-value added steps.
- The Turkish Air Force should consider long-term contractual relationships. "Long-Term" alliances can reduce administrative costs and procurement lead-time. Additionally, long-term contracts could facilitate JIT delivery arrangements that reduce shelf-life expirations.
- A market research program should be conducted or outsourced to develop knowledge base on:

1. Chemical base capability / capacity of the domestic market
2. Chemical manufacturers
3. Substitute materials
4. The possibility of implementing a CMS contract
5. Potential for an industry base that consumes the similar chemicals
6. Potential cooperation with other chemical consumers

D. SUGGESTED AREAS OF FURTHER RESEARCH

1. Evaluate manufacturer capabilities/capacities, distributors, and potential chemical consumer facilities to capture the chemical market base in Turkey and assess the feasibility of implementing a Chemical Management Service contract in the Turkish Air Force.

2. Estimate the life-cycle cost of chemical materials in the Turkish Air Force.

3. Identify commercial off the shelf chemicals in Turkish chemical markets that could fulfill the customer needs in Turkish Air Force. Assess whether current mil-spec requirements undermine competition in the domestic market.

4. Analyze the procurement lead-time of the chemicals procured via FMS, NAMSA and Commercial Sales. Identify factors that contribute to long lead times.

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